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Underwood and Underwood.

The Origin of Man from the Anthropoid Stem When and Where?

(From Bicentenary Number of American Philosophical Society's Proceedings, Vol. LXVI, 1927)

By WILLIAM K. GREGORY

PROFESSOR OSBORN has recently argued that for more than one million years past our ancestors have been erect-walking, large-brained, speaking men, not differing in essentials from the human genus of to-day and contrasting profoundly with the arboreal or semi-arboreal great apes.

This immense vista of man's antiquity and of his aloofness from other mammals has called forth more than one expression of thankfulness that the much maligned human race has at last been freed by anthropological science from a degrading sense of kinship with apes and monkeys—repulsive creatures whose very names in ancient and modern times have been used in contempt and derision. This bar sinister in man's reputed pedigree has been viewed with horror by many anti-evolutionists, who have sought by every artifice of rhetoric to discredit the idea; but scientists of world-wide reputation have also striven either to secure a verdict of "not proven" or to establish a complete alibi for mankind.

And now Professor Osborn hands down a decision at first sight quite adverse to the claims of the anthropoid tribe to the place of honor as man's next of kin. Specifically, he holds that these animals "constitute a separate branch of the great division of primates, not only inferior to the Hominidæ but totally disconnected from the human family from its earliest infancy."

But, like the slave in the classical story whose unpleasant and doubtless risky duty it was to remind royalty "*Memento te hominem esse.*" I conceive it as my hard duty to remind mankind that these poor relations of ours, mute witnesses of the past, are still with us and that the evidence of our lowly origin can hardly be waved aside on the ground of the length and aloofness of our own lineage.

If we concentrate our attention on the evidence for the, at first, almost inconceivable antiquity of man as an independent family, we may easily forget that the Pliocene epoch is next to the nearest to us of a long line of known geologic epochs, most of which are many times longer than the Pliocene itself. If we accept Barrell's estimates based on the rate of disintegration of uranium into lead and helium, we find that even the Lower Pliocene is only some six million years distant from us, while the beginning of the Eocene is set down as some sixty million years ago. And what is this in turn, compared with the 700 millions of years since the beginning of the Palæozoic? At most, the human race has then been proved to be a superior line of its own for less than one hundredth part of the time that bivalve molluscs have been separate from univalves or sponges from corals.

Man is not the only mammal of the Pliocene epoch that was already substantially like his modern representatives. Palæontologists have shown that the same is true of the

horses, tapirs, rhinoceroses, elephants, bears, pigs, monkeys, apes and many other mammals. In other words, the amount of evolution that has apparently taken place since Pliocene times in all these groups appears at first sight to be surprisingly slight.

However, if the geologic epochs themselves extend as many millions of years as they are supposed to do, is it any wonder that the old "phylogenetic trees" have been lengthened into clusters of nearly parallel lines, converging only at extremely distant points? But because horses and asses may have been on separate lines far longer than was formerly thought are they in reality any less nearly related to each other than they were before? And in general are zoological relationships, *e.g.* of the horse to the rhinoceros and the tapir, really altered because our ideas of the antiquity in years of all creatures has been greatly expanded?

Partly because the amount of evolution since Pliocene times appears at first sight to have been very slight and because evolution in the horses, proboscideans, and many other families has usually been extremely slow throughout the Tertiary period, it might be suspected that evolution in man has been equally slow and that man will be proved to be distinct from other families as far back as the families of horses, rhinoceroses, proboscideans, etc., were separate from each other; that is, as far back as at least the Eocene epoch.

However, primitive horses, with undiminished side toes and short-crowned teeth, in general characteristic of the Oligocene epoch, persist in the Miocene, side by side with more progressive families with reduced side toes and long-crowned teeth, leading to modern horses. So, too, it is generally recognized that certain groups have changed but little during enormous reaches of geologic time, while others have become profoundly specialized during the same period. Among the mammals, the opossum has come down to us with only slight modifications in the dentition from the primitive marsupials of the Upper Cretaceous. The family of horses, on the other hand, during the same period underwent intensive modifications. In view of all this, where is the direct evidence that the evolution of man has proceeded at approximately the same average rate as that of the horse and his congeners, and that the two families date back equally far in geologic time?

Before taking up the direct palæontological evidence on this matter, let us consider several lines of indirect evidence.

If man and ape had parted company as long ago as did tapir and horse, their relatively higher instability should have made their molar patterns far more different from each other than those of tapir and horse, whereas the contrary is the fact. This assuredly adds weight to the argument that the kinship of man to the chimpanzee is

far closer than that of the tapir to the horse, and that the separation of the first pair was a much later event than the separation of the second pair.

Those who oppose Darwin's conclusion that man is an offshoot from the anthropoid stem must attribute to "parallelism" the numerous resemblances between the anthropoid dentition and that of man, notwithstanding the fact that these resemblances persist in spite of the profound differences in diet between the prevailingly frugivorous apes and the prevailingly carnivorous-herbivorous man. But if the very numerous detailed and fundamental resemblances between anthropoid dentition and that of man are due to parallelism, what warrant is there for using quite similar dental resemblances and differences for uniting and distinguishing the members of the families of elephants and odd-toed hoofed animals?

In judging the interrelationships of the members of any large group the evidence derived from the dentition should of course be supplemented and checked wherever possible

according to the well established principle of adaptive radiation, after the descendants of an ancient common stock pass from the ancestral life-zone to a new one, their whole locomotor skeleton becomes adapted to the new mode of life. It is well known that these new adaptations tend to cover-up and obscure the characters inherited from the older environment and contrasting widely with each other in their modes of locomotion, show the maximum contrast in their hind limbs, whereas the horse and the tapir, continuing to use their limbs in much the same way as did their remote common ancestors, differ from each other chiefly in the fact that in the horse tendencies toward centralizing the axis of the foot, which are already clearly visible in the tapir, have been carried to the extreme. And it will be shown presently that in spite of the striking difference of the human foot from that of the chimpanzee, its origin is perfectly explicable on the hypothesis that it has been derived from the foot of a primitive anthropoid type by a definite change of function involved in the abandonment of arboreal life and the assumption of bipedal running habits.

The striking difference between the foot of the anthropoids and that of man has led Sir Ray Lankester and others to regard the evolutionary gap between anthropoids and man as equally profound and has been the principal objection to Darwin's theory of the origin of man. This brings us to the very kernel of the whole question, namely, was man's place in nature correctly determined by Darwin, Huxley and Haeckel; is he still definitely the next of kin to the anthropoid stock, or does he represent an entirely independent group of unknown origin and relationships?

(Prof. Gregory's answer to this question will appear in our next number).

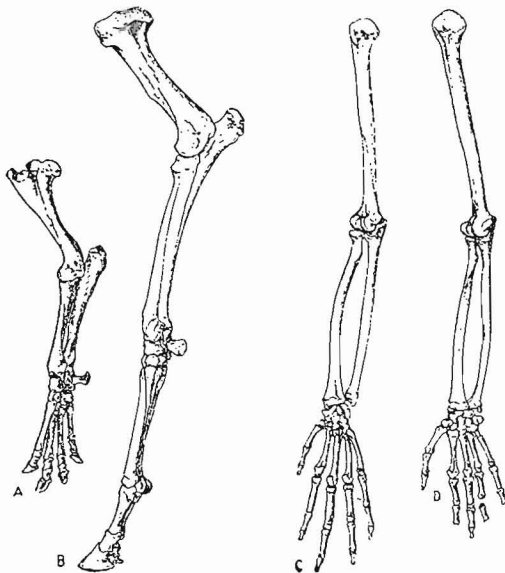


Fig. 1.—Skeleton of right fore limb of A, Tapir; B, Horse; C, Chimpanzee; D, Man (Veddah). C and D after Sarasin.

by the characters observed in other parts of the body, especially the skeleton of the limbs and feet. Let us apply this test to our inquiry as to whether chimpanzee and man are more nearly allied in structure than tapir and horse. Fig. 1 will enable the reader to compare the forearm and hand of chimpanzee and man on the one hand and of tapir and horse on the other.

Is the difference in the forearm and hand of chimpanzee and man anywhere nearly so profound as that between tapir and horse? Here the evidence suggests that even on the assumption of equal changes in equal times, chimpanzee and man have not been separated nearly so long as have tapir and horse, and again it will be noted that this greater resemblance between chimpanzee and man persists in spite of the marked difference in their habits.

The differences between the hind limbs and feet of chimpanzee and man, while very conspicuous, are on the whole not nearly so great as the differences between the hind limbs and feet of tapir and horse (Fig. 2). Ac-

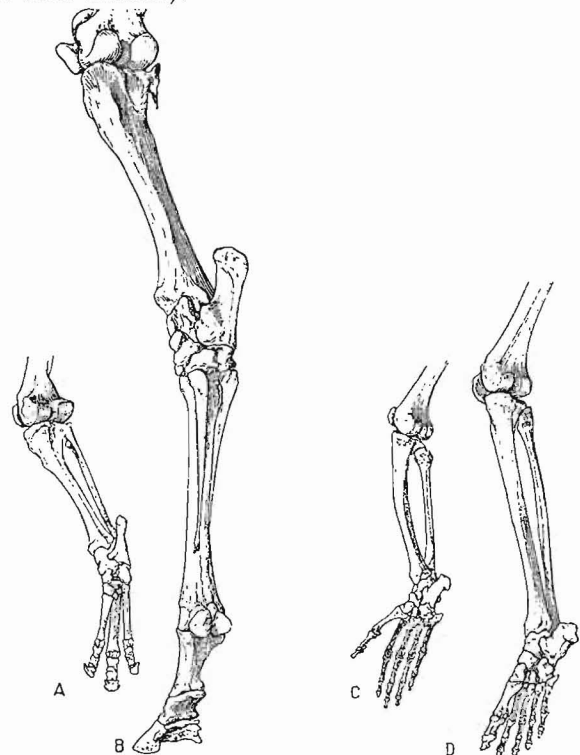


Fig. 2.—Skeleton of right hind limb of A, Tapir; B, Horse; C, Chimpanzee; D, Man.

Brains—How Come?

By ALLAN STRONG BROMS

V.

MAN'S big advantage over his fellow animals is his adaptability. He got that from the babies. Paradoxically, they helped him by being helpless. They did the finest job of brain building ever—for man's is not only bigger, but really different. Yet it grew out of the animal brain and certainly was not a special creation.

The animals—meaning the other animals—act by instinct. They are born that way. For instincts are just race habits, inherited and all set to go. Being on hand at birth, they need not be learned and they fit the animal young to start off living full-fledged. Our babies can't do that; *but they can learn*. Grown up, they beat the world.

Our babies are helpless for lack of the self-preservative instincts. That sounds like a handicap, but it's an asset,—if there are parents around to substitute at preserving from hunger, cold and danger. With parents on the job, instincts are superfluous and only tie us to ways of our ancestors, ways once good in their time and place, since natural selection picked them for race habits, but now out-of-date. For the world has moved and new problems face us. Our ancestral ways have turned to handicaps and must be done over for present fitness.

But how change? One of two ways. By natural selection through the survival of such children, grand-children, great-grand-children, great-great-grand-children, and so on, that happen—just happen—to vary towards fitness to the new times and places. Either that way, or through the adaptable mind, that can learn how *now*, that can train to do in new ways and think out solutions for new problems. The animals, instinct guided, win in the gamble for survival if their evolution beats the environmental changes. Man beats them all through quick changes, by training and invention. For that he must thank the babies.

For the baby (protected by parents), can start off with a clean mental slate. He is not cluttered up with wrong answers, with out-of-date instincts that served the simple jungle needs of his ancestors, but can never meet the complex needs of our human lives. The clumsy and inarticulate baby can do almost nothing to start with, but potentially he is a Jack-of-all-trades. He starts as a squirming bundle of waste motions,—kicks, gurgles, wails, and waving arms. There are lots of motions to pick from and some prove useful (pleasurable) and survive through repetition. The others lapse through disuse or are suppressed as in the way. Repetition gives skill to the survivors, for practice makes perfect. These acquired habits are ruts like instincts, but we make

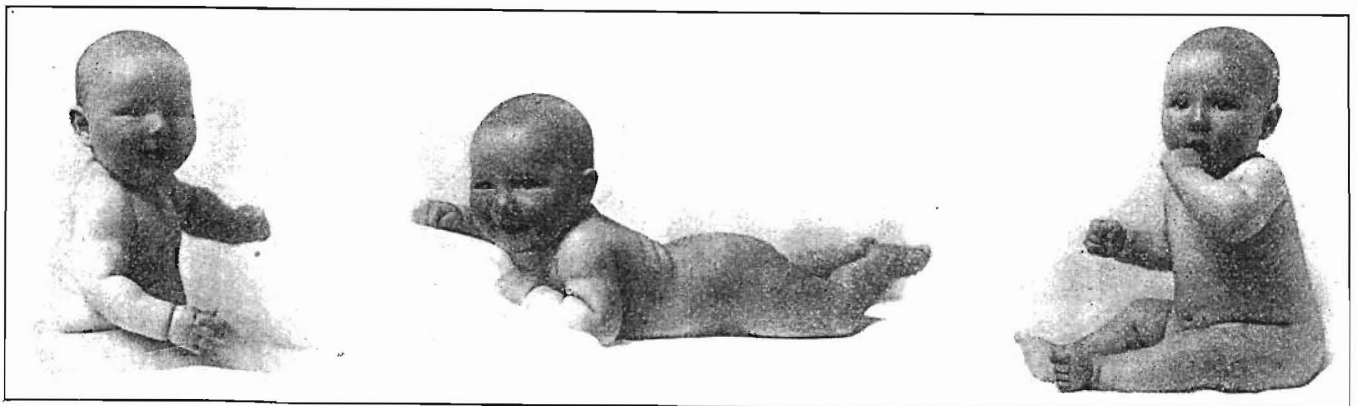
them ourselves to fit present needs and we can change them if need be, for they are less deeply rooted. Once acquired, they serve as the mind's private secretary, attending to routine details and leaving the big boss mind to tackle new problems.

For also, the human mind invents solutions for problems. Not so the beast's. He is all primed to act, not to think. Something in his world touches him—through ears, eyes, nose, touch—a stimulus. He responds with automatic action—trigger-quick—instinctively. In his jungle world, he who hesitates is lost. Man's world is fairly free from such dangers, but full of complex problems, and many apparent solutions, some right, some wrong. So he must choose and combine acts and means in new ways to get new results. In his world, he who does not hesitate—and think inventively—is lost.

For such thinking and doing, man needs a lot of facts and training, true facts about his world, what he may expect of it and what he can do with it, and trained skill in his many, diverse doings. So much learning needs a lot of time for education, time free from the cares of serious labor and living. Childhood, under parental care, gives that carefree time. With us it may average sixteen to twenty years when we can play at living—which is good practice—and experiment with this and that — and soak up lots of useful facts, before we settle down to business. Through this period of "schooling" we get human adaptability, our big lead on the other animals. You can almost measure the adaptive intelligence of any animal by the length of its infancy. The mammal mother, nursing her baby, watching over it, playing with it, took a big step forward towards better brains. And because our babies start off with just enough instincts to get by with under parental care and take so long in growing up, we ourselves finish up well informed, skillful and resourceful, able to make so much of the world into which we come. We take more time getting ready, so we do a better job.

The babies really made us, of course with the help of better seeing eyes, handy free hands, and improved brain connections and other good aids to body and brain. Also they made us *over*, gave us parental and family feelings, the real bonds of matrimony being baby ribbons. That made a fine foundation for the other social sentiments which followed and made us all a lot easier to live with. Brain and so-called soul, we owe them largely to the babies.

The next article will be on "The Inside of the Brain Works".



A bundle of waste motions and unbound capacities.

—Courtesy Billy Katterfeld

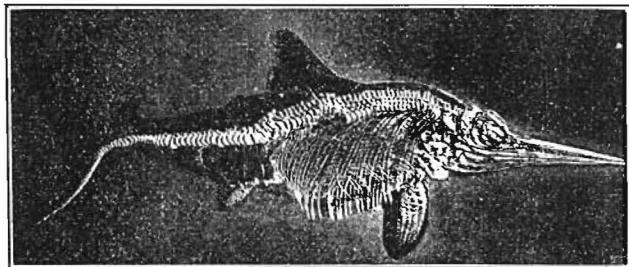
Rulers of the Ancient Seas

By FREDERIC A. LUCAS

Honorary Director, American Museum of Natural History

JUST as Greece, Carthage and Rome in turn ruled the seas in the days we call old, so, long before the advent of man, the seas were ruled by successive races of creatures whose bones now lie scattered over the bed of the Mediterranean. For a time the armor-clad fishes held undisputed sway; then their reign was ended by the coming of the sharks, who in turn gave way to the fish-lizards, the Ichthyosaurs and Plesiosaurs.

Though they were big for reptiles and some were real giants, fifty feet long, they do not merit the adjective "gigantic" so liberally bestowed upon them. They were of many species of assorted sizes. The smaller Ichthyosaurs were, so to speak, reptilian porpoises, but provided with four useful paddles instead of just two, in addition to a powerful tail whose shape and use were long unsolved problems. This long tail was bent at a sharp angle to the backbone and this was taken to mean the



Ichthyosaurus (the fish-lizard) pressed flat on a rock slab.

—Courtesy Am. Museum Nat. Hist.

existence of horizontally flattened tail. But when a finely preserved specimen came to light, lying upon one side and having the tail in place, lo it was much like the tail of a shark, only reversed, the lower lobe being longer than the upper. This means that the reptile came to the surface to breathe, while the shark goes down in search of food and to escape danger. The more perfect specimens also showed an unsuspected high back fin precisely like that of a porpoise.

The long-necked Plesiosaur was like "a snake threaded through the body of a turtle", the shell, however, being lacking, as the body was covered by a smooth skin. Despite the snake-like neck, the Plesiosaurs may have been a stiff-necked tribe on account of their biconcave vertebrae.

Having played their roles of rulers of the seas, Ichthyosaurs and Plesiosaurs in due time passed off the stage of life to give place to the great marine reptiles called Mosasaurs, that extended their empire around the world, from New Zealand to North America. Great they were, but there is a universal tendency to magnify the reptile we never saw as well as the fish that "got away," and the greatest of animals will shrink before a two-foot rule. No animals known to have existed were ever larger than our whales and few Mosasaurs exceeded in size a first-class Crocodile. Very rarely a Mosasaur reached a length of forty feet and even twenty-five feet is large, while the great Mugger, or Man-eating Crocodile, may attain a length of thirty feet, a fit match for most Mosasaurs.

The first of these sea-reptiles to be discovered now reposes in the Paris Musée d'Histoire Naturelle, after having changed hands several times. The original owner, M. Hoffman, presided for weeks over the arduous task of separating the remains from the surrounding rock. The extraordinary discovery excited so much interest that the canon of the nearby cathedral, as lord of the manor, laid claim to the fossil and succeeded, after a long and harassing lawsuit, in obtaining the precious relic. But during the French Revolution, the armies of the Republic, advised by a committee of savants, spared from bombardment that part of the city in which the fossil was known to be. Shrewdly sus-

pecting the reason for the peculiar favor shown his residence, the canon concealed the specimen in a vault; but when the city was taken, he had to give up his ill-gotten prize which was then moved to its present museum location.

The seas that rolled over western Kansas were the headquarters of the Mosasaurs and thousands of specimens have been taken from the chalk bluffs of that region, some so well preserved that we are well acquainted with both internal structure and outward appearance. They were great, overgrown, swimming lizards adapted to a roving, predatory life by their powerful tails and paddle-shaped feet. Their cup-and-ball vertebrae gave great flexibility of body, their sharp teeth helped capture slippery prey and the structure of the lower jaw shows that they bolted their food in great chunks. In snakes, which also swallow their prey entire, the two halves of the lower jaw are loosely over the gape of the mouth. The pelican solves the same problem by the length of his mandibles which bow apart to form a nice, little landing net. In the Mosasaurs each half of the lower jaw was joined so as to bow outward when opened and to add greatly to the swallowing capacity. Extend your arms at full length, the palms touching, and then bend your elbows outward and you'll get an idea the action of a Mosasaur's jaw.

The western sea was a lively place in the day of the great Mosasaurs, for with them swam the king of turtles, Archelon, a dozen feet in length, its head a full yard long. In the shallows prowled great fishes with massive jaws and teeth like spikes and the great, toothed diving-bird Hesperornis. Over the waters flew pterodactyls, reptiles with a wing-spread of twenty feet, largest of all flying creatures and very probably



Tylosaurus; terror of the Kansas seas. — Am. Mus. Nat. Hist.

flesh-eaters too. When all these were seeking their dinners, there were troublous times for smaller fry in that old Kansan sea. Then came a change. To the south, west and north the land was slowly but surely rising, only an inch or two in a century, but still rising. Its area contracted and ridges of the sea-bottom came to the surface as long, low bars that imprisoned the sea-life and subjected it to many risks. The stronger more readily captured the weaker and the fishes gradually died out through the constant freshening of the water. With the death of each considerable group, the balance of food supply was upset and many large species disappeared from the scene. The more omnivorous and enduring long resisted starvation, but finally yielded to inexorable fate—the last was caught in a shallow pool from which his exhausted energies could not extricate him.

Man Carries His Past With Him

By CLEVELAND SYLVESTER SIMKINS

ON a slab before me lies the partly dissected body of a man. Several things about this body immediately attract the attention of one accustomed to looking upon the human insides. The muscles on the belly and chest differ from the great run of men. The straight belly muscle instead of ending at the lower border of the breast bone runs to the root of the neck and blends with the muscle leading from collar bone to back of head. This condition occurs once or twice per hundred people. Very few physicians ever see it, since they usually dissect but one body in their entire career. So it is only the trained student in the structure of the human body that asks and tries to answer the question: How came such variation to be?

The easiest way to answer the question would be to call it a whim of providence. But the scientific student will look for possible cause. One is an injury. He finds no scars, no tough bundles of repair tissue; so he discards the injury suggestion. Another is faulty development. Can this be a reversion to an ancestral condition?

The muscles on the belly of the lizard run from the pelvis to the lower jaw in a continuous series, very much like the muscles of the body on the table before me, suggesting the possibility that this is a reversion.

If the straight belly muscle is examined in any normal man, closely and carefully as the dissector does over the dissecting table, four strips of gristle will be found running across it. These strips did not just happen to be there. There's a reason. It is found in the reptiles.

In reptiles the belly muscles are separated into a series of segments, with ribs separating the muscular bundles. Ribs on the belly? Exactly. And these ribs gradually disappear as the reptiles transform into mammals. But in their place is left a series of strips of gristle as representatives of these ancient ribs. Mankind, without exception, shows these marks of reptilian origin. Monkeys and apes also show that they too came from the same remote stock.

In the same body that showed such strange condition the muscles the vermiform appendix was very long and coiled about as big around as a lead pencil. Usually in man it is two or three inches long. In this case it was fully six, yet showed no evidence of any function whatever. Why is it so absent in man, usually so small, and here so large? Why present at all? Merely to plague the life of man? It means.

Its function must be looked for in the bowels of the animals. All animals that live upon grass, herbs and have a well developed caecum, corresponding to the appendix. It aids them in the absorption and digestion of herbs and grass. Animals that live upon flesh have a very simple digestive in comparison, with no vermiform appendix, or one much reduced. In the orang, a fruit eater, the appendix is long coiled, as in the cadaver just dissected. In the gorilla, living upon herbs and fruits with a minimum of flesh, there is a long and spiral appendix. The chimpanzee, however, whose bowels more closely resembles that of man, has a relatively short appendix.

The function of the appendix seems to have been connected with the digestion of herbs and fruits. As the diet changed the structure and form of the appendix. Man, who eats much of that cooked, has very little need for the appendix, and nature is slowly getting rid of the useless structure. In some individuals she succeeds in eliminating it entirely; in others she only reduces it, while in still others with a tendency to revert to ancestral type the appendix is correspondingly large.

The human body contains over one hundred organs that show this tendency to revert to the type of man's ancient ancestor. To call attention to each one of them would require a good book. Every one of them illustrates the fact that man has evolved from a very lowly ancestor.

THE GOLDEN LAW

By FRANK GOSLING

*"All matter, mind and spirit, all is mothered out of strife,
The Iron Law of Struggle is the Supreme Law of Life".
'Twas thus the poet ended. Yet, in stanzas five above,
He'd never mentioned altruism! No, nor Mother-love!*

*Now, half the truth won't satisfy the philosophic mind!
It surely doesn't follow that we can't leave strife behind!
"There never was nor will be from the strife of life surcease"
Is too dogmatic while 'The Riddle' plays the mystic Fleece.*

*"Time never was when it was not."—The poet, p'raps, was there?
If not, he ought to say 'I think': the open mind won't dare
To use a poet's license thus in writing of the days
When laws long-lasting may, perchance, have 'worked' in other
ways!*

*An early sexless being might have said "there can't be Love,
I've made investigation, finding nought but Push and Shove!
'Time never was when such was not—and, therefore, don't you
see,
This thing called Love can never, never, never, never be!"*

*And Sabretooth, though tasting love of mate and, p'raps of cubs,
Could hardly dream of other-love!—And that's just where it
rubs!—*

*Of present, past and future, with Einstein knocking round.
We need to speak most cautiously,—be careful of our ground.*

*The pseudo-scientific misinterpretation sad
of Darwinism, leads to War! And fratricide seems mad
Kind Darwin never, never preached that we must ape the
He surely guessed the other way Humanity might shape.*

*It seems to be a law of nature, nature shall be fought!
So why not turn our human minds to bring life's strife to no
And thus, in fighting nature, win some peace for Man at last
With yet, perhaps, a modicum for fish and bird and beast*

.....

*A quibble? Maybe, Yes! It seems some struggle must remain
We find it hard to think of Life without we think of Pain
Yet talk of 'strife', unqualified, allows the babe or fool
To dwell upon the 'brute' and miss the Strife-won Golden*

Perpetrated 1-12-28, by F. Gosling, of 23, Newick Road, Clapton, E. 5, as an attempt to counteract the effect of the beautiful poem of John Hall in 'Evolution' (Oct. 1928), upon those who have not gone so far in thought as he has. No offense whatever intended!

How Long Will the World Last?

By JOSEPH McCABE

SCIENTIFIC men have differed much in the last fifty years as to the past age and probable future of the earth. The mathematician was correct, but the physicist gave him the wrong material for his sum. How can he be sure that he now has the right material? He cannot be absolutely sure, but I will explain how little room for doubt there now is about the matter. There is a general agreement about the point, and the skepticism of people who know no more about the subject than they know about the arteries of a codfish, is as idle as the crackling of thorns under the pot.

Until twenty years ago we had three chief ways of determining the age of the earth which is closely connected with the question how long it will be fitted to sustain life. The water of the ocean was originally fresh, because its salts are being actually conveyed into it today by the rivers. The water itself notoriously evaporates, leaving the salt behind, and returns, with a fresh burden of salt, in the rivers. In other words, the proportion of salt in the ocean is steadily increasing, and by analysis of the water of many rivers we can ascertain, roundly, what quantity of salt is added to it yearly. Obviously, the further we go back in past time, the less salt there would be in the ocean, and it is a fairly simple mathematical sum to determine how far back we must go to find the waters of the earth free from salt. Somewhere about seventy million years, said the experts.

There was always a recognized weakness in this estimate. It supposes that through all geological time the rivers bore to the sea much the same proportion as they do today. The same weakness, one may say the same unjustifiable assumption, lay in the purely geological method of calculating the age of the earth. The rivers bear mud and sand and stones to the sea; where new strata are formed, and patient investigation can find what burden of sediment the great rivers transfer from the land to the ocean-bottom every year. American geologists have thus calculated how much of their precious land is deposited on the floor of the Atlantic and Pacific every year. When the majority of geologists working along this line reached a conclusion not very different—between fifty and a hundred million years for the formation of the stratified rocks of the earth, it seemed impressive.

The fallacy or weakness in both cases is to suppose that during all geological time the rivers bore, on the average, much the same load of sediment to the seas as they do today. It is a big assumption in the case of a globe which, as we now know, has had so many ups and downs in the course of its life.

Another mischief was that, on a third

and quite independent line of reasoning, Lord Kelvin gave a figure for the age of the sun which seemed to harmonize with, and confirm the geological estimate. In those days men could see no substantial source of the heat of the sun and the stars except the compression of the matter composing the globes, and Kelvin started from this theory. We now know a source of heat which is enormously more effective and would sustain the temperature of the sun during a period of time twenty times as long as the longest period assigned by Kelvin.

This source is radio-active matter (uranium, thorium, etc.), the heat-producing quality of which we realize as an absolute fact in the laboratory. We have only to suppose that the interior of the stars is composed of masses of these heavy and unstable metals, and we have, since we know their weight, a source of heat which will last for billions of years.

It is always amusing to listen to the gentleman who prides himself on his common sense and asks us to be skeptical about these estimates and theories. Most of his own opinions about cosmogony are inferences drawn by imperfectly educated dervishes from bad translations of forged documents of an age of colossal ignorance; but his opinions are sacred enough to be protected by gunmen if necessary, while he can smile at an opinion laboriously reached by a thousand mathematicians of almost magical skill, profoundly critical judgment, and years of the most learned calculations. The mathematician asks the physical astronomer—though the two branches are really combined, since every astronomer is a good mathematician—what the probability is that vast stores of radio-active matter exist in the sun. We cannot prove it, as we can prove the existence in the sun of oxygen or iron, because our instruments analyze only the glowing surface of the sun. But it is an elementary truth of astronomy that the lighter elements remain at the surface of a globe and the heavier elements lie below—it is just as natural a process as when you see the stones brought down by a river remain in its bed while sand is taken out to the seashore and the fine mud borne far out to sea—and no one with any knowledge of these matters can have any doubt that there must be vast quantities of the heavy radio-active metals in the interior of the sun.

A few grains of uranium notoriously give off heat and other forms of energy, and one has at once a vague idea of the possibility if we suppose that billions of tons of this material exists in the sun. But we have another matter to take into account; the terrific pressure put upon the central matter of the sun and stars by the mass of the globe. As the total weight of

the sun is well known, this pressure in the interior can be calculated, and the effect on the material can be gathered. The state of matter in the interior of the sun, or even of the earth, is beyond the power of our imagination, but the abstract formulae of the mathematician can penetrate to the very heart of it, and for those who are interested in these matters the modern analysis of the interior of stars is as impressive as it is fascinating.

The total energy poured out by the sun every minute or year is known. The amount of radio-active matter needed to give off that energy—astronomers now say to be converted into that energy—is known. The weight of the sun is known. Naturally one must not regard this conclusion as "mathematical" in the same sense as the addition of your bank-balance is. For most of us it is enough that the masters of this branch of science have, after ten or more years of critical and laborious estimates, agreed that the sun will probably continue to give light and heat enough to support life on this planet for a future period which is nearer two hundred million years than one hundred.

What matters to us is the value of this conclusion to our human outlook on life. We count our civilization as five or six thousand years old, and it is still so foul with injustices and stupidities that many wonder occasionally if the human endeavor is not futile: if history is not going to be always a series of advances and retrogressions into Dark Ages. On the other hand we have the thoughtless crowd and the imperfectly or wrongly educated people who seem incapable of visualizing any higher civilization than ours.

I am confident that much of this thoughtless attitude could be corrected if the school planted so deeply in the minds of pupils this new conception of the meaning of life that they could never wholly forget it. What are five thousand years in face of this stupendous future of the race? We learn a healthy contempt of our own institutions; and by a healthy contempt I mean the sure and steady realization that every institution or idea of which we may be proud today is child-like in comparison with the ideas and institutions of the future. We may be fully human, but we are the infants of civilization. It has hardly yet begun. Tens if not hundreds of millions of years of scientifically ordered life lie before us.

—U. B. U. Bulletin.

RUBE: What do you think about this here Evolution?

YOKEL: It's a good idea—but can they enforce it?

—American Boy Magazine.

EVOLUTION

A Journal of Nature

To combat bigotry and superstition and develop the open mind by popularizing natural science

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JANUARY, 1929

CONVENTION REPORTS

As this issue of EVOLUTION goes to press the world's greatest gathering of scientists is convening. Undoubtedly from their sessions will come forth many a message marking an advance in science, pushing farther out the frontiers of human knowledge, perhaps throwing a searchlight beam from our little island of light into the encompassing ocean of darkness. And they may give us an inkling of what the scientific method means, an appreciation of the thoroughness and infinite care that attend the announcements of scientists.

The next number of EVOLUTION will contain some informal reports of the Convention.

A RESOLUTION NEEDED

Surely it is not too much to hope that from the Convention there will issue a call to mobilize the friends of science for the pending struggle against organized religious bigotry. May it speak in unmistakable terms to those who would turn back the hands on the clock of progress by passing laws against the teaching of evolution. Certainly the Advancement of Science demands a militant championship of the right of teachers to teach the truths of science. Anything less would be a denial of all sense of social responsibility.

ALMOST TWO TO ONE

The vote on the anti-evolution referendum in Arkansas is reported as: YES 108,991; NO 63,410. Majority 45,581. It is interesting to note that the heaviest vote AGAINST the proposed law was cast in some of the solidly fundamentalist rural districts. This is explicable only on the theory that these good people were confused by the awkward wording of the question and thought that by voting NO they were voting against the teaching of evolution. There's a real man's sized job ahead, friends, to educate the people.

IDEAS TO CLASH IN NEW YORK

A real clash of ideas will take place when Rev. W. B. Riley and Joseph McCabe meet in the great evolution debate, Thursday February 7th in Mecca Temple.

This will not be a mere war of words between elocutionists to entertain an audience. Each speaker is in deadly earnest. Each will do battle for his most profound convictions. Each, through a lifetime of activity on behalf of those convictions, has already achieved world-wide recognition as their champion.

Rev. W. B. Riley, President of the World's Christian Fundamentals Association, is prime mover and chief organizer of the anti-evolution campaign. He has participated in twenty debates on evolution, and according to the judgment of the audiences he defeated the evolutionist in all but one of them.

Prof. Joseph McCabe received his early training in the Catholic Church and was at one time in a monastery, but he now has back of him thirty years of fighting for freedom of teaching. He is known on three continents as the greatest popularizer of science. Wherever English is spoken live his students and disciples.

These two champions have met in the arena before. According to Rev. Riley, Prof. McCabe is the only man who ever won a decision over him in debate, and that before a rationalist audience in Chicago. At their most recent meeting in Toronto, Canada the audience voted three to one for Riley and against evolution. Of course it is only fair to state that there they were overwhelmingly fundamentalist.

So each speaker will be specially anxious to win the approval of the cosmopolitan audience that New York will furnish for this final and decisive debate.

In addition to the vote of the audience, it is planned to have a committee of thirty-three judges.

EVOLUTION is naturally pleased at being instrumental in bringing two such outstanding personalities together in this city. We do not care very much who proves to be the better debater, nor how the audience and judges vote. Our purpose is to cultivate the Open Mind. We believe that the more both sides are heard, the more we shall win over the forces of fundamentalism. Rev. Riley has a similar faith in his plea. Hence the debate.

This promises to be such an intellectual treat as has never before been offered in this city. It is a tremendous undertaking for such a youthful journal as EVOLUTION, and the co-operation of every reader in the East is invited to make it both a moral and a financial success.

Start right now to organize a "line party" for this debate among your friends. Readers as far away as Boston and Baltimore are expected to get up groups to come to New York for this occasion. Teachers should plan to bring their students. All desiring blocks of seats should reserve them at once.

OF INTEREST TO SCIENTISTS

Most of the science articles appearing in EVOLUTION popularize matters with which every well informed scientist is already familiar. This is necessary to make the journal of value to laymen. But in every issue we expect to have at least one article carrying in somewhat abridged form the essential information contained in studies published in scientific journals, which because of their limited circulation are not yet generally known. For instance, the article by Dr. J. Leon Williams on "New Evidence of Man's Relationship to the Anthropoid Apes" in our last number, and the article by Prof. Wm. K. Gregory in this issue.

During the course of the year EVOLUTION will contain much material that is new even to the best informed men of science.

"THE FIGHT IS JUST BEGUN"

EVOLUTION has endeavored to impress upon its friends the fact that the anti-evolution agitation in Arkansas is not a mere local phenomenon growing out of the supposed backwardness of that State, but the beginning of a far-reaching campaign of fundamentalist fanatics to dominate the schools. Here's confirmation from the official organ of the American Anti-Evolution Association, the *Baptist and Commoner*, of November 21st, 1928:

"The evolution fight has just started. Other states will be encouraged to make the fight since we have won in Arkansas. Some of the legislatures may pass the law and other States can initiate it as we did in Arkansas. Yes, we need money to push the work all over the land. It is like the prohibition fight. We went on with it for fifty years until we got national prohibition and now the work is to enforce the prohibition law. It will be the same way with evolution fight. THE FIGHT IS JUST BEGUN. We have won in Arkansas but there are forty-five other states where the fight must be made and then even after that we have the rest of the world. Let us get narrow provincialism out of us and have a world vision for all the work. There are many people who live outside of Arkansas and many who live even outside the United States. Let us make evolution illegal all over the world. Let us thank God and take courage."

This should help to disabuse those gentle, diplomatic friends who thought that by "keeping still" and "keeping out of Arkansas" they would "refrain from arousing prejudice" and thus fool and defeat the fundamentalists.

Only an aggressive campaign of popular education can save the day for science. EVOLUTION will co-operate with every such endeavor.

The Text Book Hoax

An expose of the hypocrisy behind the publication of biology text books.

By BARROW LYONS

UP to the present, no serious attempt has been made in Arkansas to keep the dictionaries out of the schools, which make perfectly plain the basic idea of evolution. Yet the influence of the Fundamentalists has made itself felt quite enough. Even before the Scopes trial they had succeeded in impressing their blight upon the authors of biology text books through bringing pressure to bear upon the members of text book commissions.

Usually the gentlemen on these commissions, being good natured, accomodating and particularly anxious to keep out of unpleasant controversies involving religious prejudices make no very stirring effort in behalf of science. They take the easiest path and adopt texts certain not to get them into trouble with the arch trouble-makers.

An interesting example of modification in text book making is furnished in the volume entitled *Biology and Human Welfare* published by The Macmillan Company in 1914. The joint authors of this book were James Edward Peabody, head of the department of biology at Morris High School, New York City, and Arthur Ellsworth Hunt, head of the department of biology at Manual Training High School, Brooklyn. In their preface they say:

"The field of biology is so large and some of its problems are so difficult that a wise selection of topics must be made if a text is to attain its maximum usefulness. Consequently, some topics that are often found in secondary school texts, but are more suitable for discussion in advanced courses, have been omitted. Among these may be mentioned Mendel's laws, theories of evolution and mitosis."

There is a footnote to the word evolution, which reads:

"The prominent evidences of relationship suggesting evolution, within such groups as the decapods, the insects and the vertebrates, should be demonstrated. A few facts indicating the struggle for existence, adaptation to environment, variations of individuals, and man's selective influence should be pointed out; but the factors of evolution and the discussion of its theories should not be attempted."—Quoted from the syllabus in advanced zoology published by the College Entrance Examination Board and the New York State Department of Education (1921). This syllabus is based upon the report of a committee of the American Society of Zoologists, Eastern Branch."

Dr. Peabody has been criticized as giving the impression that the American Society of Zoologists, Eastern Branch, intended that the facts of evolution should be left out of elementary and secondary school texts, but the real intention of the zoologists was merely to suggest that a

detailed discussion of evolution was somewhat beyond the grasp of most high school students.

Mr. Peabody's argument, moreover, seems somewhat lame when one compares the text of his earlier book, *Elementary Biology* written in collaboration with Mr. Hunt in 1912, in which the grounds upon which a belief in evolution is based is set forth very clearly. There seems to be nothing beyond the grasp of high school students in the following excerpt taken from page 114:

"We have seen in our study thus far (1) that no two individual plants even of the same kind are exactly alike, (2) that enormous numbers of seeds are produced by plants, and (3) that there is inevitable competition or struggle for existence. The question, then, that confronts us is this: Which of the many competitors will survive in the struggle, reach maturity, and finally reproduce themselves? Obviously those individual plants that vary from the rest in such a way that they can best adapt themselves to their surroundings."

Here is rank Darwinian heresy stricken from the pages of the later book. And this:

"Not only can man secure new varieties of plants by watching for favorable variations and perpetuating them from year to year, but he can actually be instrumental in producing new kinds of plants, the process is known as plant breeding."

The text book commission of Texas has gotten around the difficulty nicely by changing the word *evolution* to *development*. This is illustrated in the text book entitled *New Biology* published in 1924 by Allyn and Bacon, the authors of which were W. M. Smallwood, of Syracuse University; Ida L. Reveley, of Wells College, and Guy A. Bailey, of Genesee State Normal School.

Apparently there were two editions in 1924. The text on page 156 is slightly different in each. In one text, under the caption "*Evolution*," appears the following:

"The same study of the tadpole also illustrates how animals may gradually have come to live on land, and suggests a natural explanation for the origin of land vertebrates."

In the other text, under the caption "*Development*," the book reads:

"This same study of the tadpole also illustrates how animals, which for a long time may have lived in the water, could gradually come to live on land."

It is a fine point, but it seems to have satisfied the Fundamentalists of Texas. The original edition, it is understood, is used for consumption by Northern school children, while the elimination of the word *evolution* made it fit for little Fundamentalists.

Commenting upon this situation a member of one of the larger text book publish-

ing firms explained:

"A good many of the members of state text book commissions are not themselves anti-evolutionists, but they must listen to the Fundamentalist preachers, who although very much in the minority, control large slices of public opinion. The commissions in some states have found that by leaving out the word *evolution*, that most of the subject matter ordinarily taught under evolution can be left in the texts. Probably most of the Fundamentalists themselves are not very clear as to what evolution means. Pictures which illustrate the subject seem to irritate them more than the texts."

It is to the credit of Ginn and Company that it has republished in its 1928 edition of Dr. Benjamin C. Gruenberg's *Elementary Biology* the chapter on *Applications and Theories of Evolution*, which were originally published in the book; but the firm also insisted upon having a book by the same author in which the word evolution should be omitted, even if the facts be camouflaged under other names.

"I was asked to do the same thing Peabody and Hunt had done," Dr. Gruenberg told me. "It appeared to me at first a stultification to comply. A publisher has no right to impose on the author criteria from a specific point of view arbitrarily, even if it seems expedient. I went into the woods, to my study at Lake George, to think the matter over. I decided to put the question of using the word evolution in the background and write a book, reconsidering my problem as I came up against it in the book. The final outcome was that I finished the book and hadn't mentioned evolution anywhere. I went over the work carefully. Outside of explicit mention of evolution and a discussion of the various theories, it was the same biology as I taught and had written."

"There are to be found in the Southern states and certain parts of the Middle West, whole populations a generation behind those one finds in our large cities and in Europe. Is it better that the children in the backwoods have no book at all? To me it was a problem of taking the world as one finds it, which most of us must do if we want to play with it at all."

A similar thought was expressed by a publisher, who like the others quoted, insisted that his words remain anonymous.

"Every farmer in the United States believes in evolution," he declared. "Talk with him for fifteen minutes and you can convince him that the improvement of live stock and plants is based entirely upon its laws."

"I think it exceedingly important that the social significance of evolutionary principles be thoroughly understood, yet I cannot print text books that mention or discuss evolutionary principles. It isn't because I haven't the nerve, but because I have creditors. To them a fearless stand for the truth would simply mean courting the possibility of losing business, and my

The Verdict of Science

The men of science in the United States are practically unanimous in their opposition to the fundamentalists and their anti-evolution laws. This conclusion is based on a referendum conducted by EVOLUTION among the members of the American Association for the Advancement of Science. In answer to the question: "Should teaching that Man is ascended or descended from a lower order of animals be prohibited by law?" 1078 of the 1098 ballots already received were marked NO, while only 20 voted YES.

There was a greater diversity of opinion on the second question submitted: "Should the American Association for the Advancement of Science take a militant attitude against fundamentalist anti-evolution laws?" 764 voted YES, 277 voted NO. Quite a number did not vote because of doubt as to the meaning of *militant*. The majority of three to one in favor of the Association taking a militant stand seems very impressive.

The third proposition met with even greater favor. "Should the American Association for the Advancement of Science express itself against the elimination of evolution from biology school texts by publishers in fear of fundamentalist influence?" was answered in the affirmative by 958, while only 123 voted in the negative. This shows emphatic opinion on this subject on the part of the scientific world. If this finds expression it will undoubtedly encourage the publishers of unadulterated texts on biology. In this connection the article by Barrow Lyons "The Text Book Hoax", on another page of this issue is particularly enlightening.

The fact that there actually exist some members of this most august body of science who think that the teaching of evolution should be prohibited by law is of course most remarkable. The twenty are distributed as follows: District of Columbia, 1; Illinois 4; Kansas 1; Massachusetts 3; Minnesota 2; New Jersey 2; Ohio 1; Pennsylvania 3; Washington 1; Wyoming 1. It will be noted that not a single

creditors would not have much confidence in me if they thought I were throwing business away.

"Under the laws of evolution only those will survive in the struggle for existence among text book publishers, who adapt themselves best to their environment, and their environment at present is one in which the Fundamentalists largely control the situation, at least in the elementary and high schools. If teachers who are not controlled by the Fundamentalists were to take an organized stand in the matter, perhaps the environment of text book publishers would be changed."

That is the situation. The problem of meeting it is chiefly that of the teacher—the one person most interested in the promotion of scientific information.

one of these hails from Arkansas, Tennessee, or the much maligned South.

The response to these THREE QUESTIONS submitted by EVOLUTION is very encouraging. It shows that among scientists generally there is a splendid sense of responsibility toward the public. Undoubtedly, as the fundamentalists push their campaign to control education, the scientific world will become more and more active, until even those that now take the position "the less said, the better" will realize the necessity of positive effort at popular education in natural science.

Here is the vote detailed by States:

	No. 1		No. 2		No. 3	
	Yes	No	Yes	No	Yes	No
Alabama	—	9	6	2	6	3
Arizona	—	7	7	—	6	1
Arkansas	—	6	4	2	6	—
California	1	87	61	22	74	14
Canada	—	5	4	1	4	1
Colorado	—	19	16	3	15	4
Connecticut	—	31	20	8	28	3
Delaware	—	9	7	2	9	—
Dist. Columbia	1	59	44	13	55	5
Florida	—	6	6	—	6	—
Georgia	—	6	4	2	6	—
Idaho	—	1	—	1	—	—
Illinois	+	88	68	20	82	10
Indiana	—	9	7	2	7	2
Iowa	—	22	11	10	18	3
Kansas	1	22	15	9	20	4
Kentucky	—	11	7	3	11	—
Louisiana	—	4	4	—	4	—
Maine	—	7	7	—	6	1
Maryland	—	31	21	9	27	3
Massachusetts	3	83	64	14	77	7
Michigan	—	32	21	8	29	3
Minnesota	2	33	26	8	32	3
Mississippi	—	5	3	2	4	1
Missouri	—	34	23	9	28	6
Montana	—	7	6	1	7	—
Nebraska	—	18	11	7	14	4
Nevada	—	1	1	—	1	—
New Hampshire	—	7	7	—	7	—
New Jersey	2	6	5	2	7	—
New Mexico	—	2	2	—	2	—
New York	—	49	34	13	40	—
North Carolina	—	9	6	2	8	1
North Dakota	—	5	5	—	5	—
Ohio	1	66	41	21	56	7
Oklahoma	—	21	14	5	17	4
Oregon	—	8	7	1	8	—
Pennsylvania	3	87	58	30	79	19
Porto Rico	—	1	1	—	1	—
Rhode Island	—	9	8	—	8	—
South Carolina	—	12	3	7	8	3
South Dakota	—	4	—	3	4	—
Tennessee	—	16	8	8	15	1
Texas	—	28	20	8	25	2
Utah	—	6	4	1	6	—
Vermont	—	9	6	4	10	—
Virginia	—	27	22	4	24	—
Washington	1	15	11	3	13	3
West Virginia	—	13	8	2	10	2
Wisconsin	—	23	16	7	20	2
Wyoming	1	3	3	—	3	1

Totals

20 1078 764 277 958 123

\$5,000 PROMOTION FUND

Dr. Martin Dewey, who has already been very generous in his support of EVOLUTION, has pledged himself to contribute \$1,000 to the \$5,000 Promotion Fund in monthly payments of \$100 during 1929. This brings the pledges up to \$2,000.

The amounts paid since last report are:

Albert C. Dieffenbach \$10.00; Fritz Gannon \$1.00; W. R. West \$1.00; Martin Dewey \$100.00; Mrs. T. M. Nagle \$10.00; Wm. K. Gregory \$200.00; Frederick Tilney \$200.00; Morris Weinberg \$200.00; Chas. Fuchs \$5.00; Wm. M. Brown \$25.00; M. Mark \$50.00; Howard Lillenthal \$5.00; Meyer Friedman \$1.00; A. B. Cohen \$10.; E. R. A. Seligman \$10.00; L. T. B. Light \$100.00; A. Friend \$25.00; B. A. Dyer \$1.00; F. R. Wulsin \$4.00; W. H. Waight \$4.00; R. D. Spencer \$1.00; David N. Schaffer \$2.00; Albert Bohm \$5.00; Hugh Miller \$1.00; E. C. Boxell \$4.00; Geo. G. Leidhecker \$1.50; J. S. Horsley \$5.00; Arthur Garfield Hays \$10.00; Geo. Welby Van Pelt \$5.00; S. E. Telleston \$1.00; Carl Keller \$1.50; A. Friend \$10.00; E. L. Fantus \$10.00; Margaret Crowder \$1.00; I. M. Miller \$10.00; F. K. McFarlan \$5.00; Total \$1,035.00.

Previously reported paid, \$1,175.00; Pledges \$2,000.00; Grand Total \$4,210.00.

This leaves less than \$1,000.00 to be raised to complete the \$5,000 fund for Evolution Promotion Campaign. Surely enough other friends of EVOLUTION will now step forward to push this Fund over the line with a rush.

As previously announced, a share in the Publishing Corporation is given for every \$10 paid in, and an extra voting share with every \$50.00.

HONOR ROLL

EVOLUTION measures its success by the number of readers who qualify for the Honor Roll. If the journal does not move its readers to ask others to read it has failed in its purpose. Although, of course, we hope to please the evolutionists it is not published primarily for their own edification, but as an instrument with which they may enlighten their neighbors. These friends therefore have our greatest appreciation. May we count YOU among them next time?

32 Ella A. Holmes 5 A. Bogard
17 Lida C. Brannon 5 S. Ratner
9 Frank Masek 5 A. L. Davis
6 Gustav Weiss 6 Chas. F. Clagg
6 Sam Katz 5 I. M. Miller
6 E. W. Thomas 5 E. G. Clemmer
6 G. E. Marsh 5 F. K. McFarlan
5 Chas. Kiehn

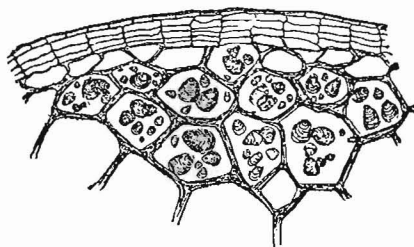
and three each from S. S. Ruck, C.H. Low, F. A. Varrelman, Emerson Miller, F. K. Fassett, Mm. McIntyre, C. M. Schoch, M. S. Deland, S. F. Brooks, F. S. Darling, W. L. Abbott, F. J. Trompou, Geo. F. Knowlton, H. D. Oppenheimer, Chas. S. Grause, Geo. A. Coleman, L. C. Daudant.

THE AMATEUR SCIENTIST

A MONTHLY FEATURE conducted by ALLAN STRONG BROMS

LIFE IN COLD STORAGE

One onion, one potato, one bean, one egg, some water and heat—sounds like a recipe, but it's just a way to take four forms of life out of cold storage. For plants and animals die or at least sleep off each winter, and must have ways of storing their lives for the next season or generation. Bulb and tuber and seed and egg are just different ways of keeping life in storage until conditions favor its active renewal and growth. All are food stores plus the spark of life, the onion a shortened stem of fattened leaves cuddled up close for warmth, the potato a thickened root.



Slice of Potato, with starch-containing cells

Look at a slice of potato, thin enough to be transparent, through a low power microscope and you will see the cells of which it is composed. The tough surface layer of flattened cells constitutes the protective skin, while the rounder, interior cells serve for storage bins. They are full of starch grains which you can see better by staining them with iodine, which always turns starch purple.

If you doubt the spark of life, give these plants a chance, some soil and moisture and warmth and watch them send out shoots ready to climb into the air and light. So with the bean, composed of a couple of leaves swollen with starch food and between them a miniature plant all set to grow when conditions are right. Put some soil in a tumbler and plant the bean at one side right next to the glass, keep it watered and warm and see it sprout, a root directed downward for moisture and anchorage, a leaf stem reaching upward for light and air. Meanwhile the old bean shrivels, drained of the food supply that gave the renewed life its quick start.

So too, the egg-stuff is food-stuff (how well we know it) encased in a protective shell and with a spark of embryonic life. Three weeks of steady warmth and your chick has its start in life, ready to peck its fat-fed self out of the emptied shell and into the busy world.

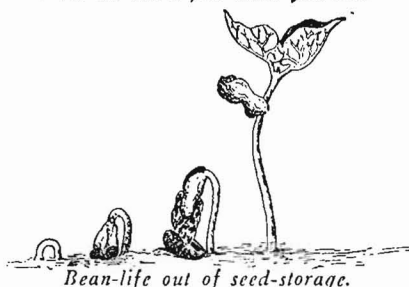
TWINKLING STARS

Winter nights are fine for observing the stars for they are longer and usually clearer, so the stars stand out brighter than ever. But summer or winter, an important difference can be noted between some of the brighter stars. Some twinkle; a few do not. Those that twinkle are true stars, great suns so many millions of millions of miles away that they are reduced to mere brilliant points of light which our strongest telescopes cannot magnify into anything but points. Those that do not twinkle are planets, worlds like our own that revolve around our sun and wander among the true stars. There are only five ever visible to the naked eye, Jupiter and Saturn, the giant worlds, Mars, the red world, Venus, the morning and evening star, and Mercury very close to the Sun and rarely seen, the baby of the system. All the planets are within some tens or hundreds of millions of miles, close enough for even small telescopes to show their round disks illuminated by the sunlight.

Why do true stars twinkle and planets not? We will find the reason in our own eyes. The retina of the eye, that inner, sensitive surface on which the light falls, consists of minute columnar cells packed close together with their small ends facing the light. The image of a planet's disk, focused as on a ground-glass by the camera-lens of the eye, is large enough, even though the naked eye cannot see it as a disk, to overlap several of the cell-ends so that some of them are constantly lit up and the light appears continuous. The disked planet therefore does not twinkle.

The light image from a true star, however, is a sharp point, so small that it does not overlap from one sight-cell to another. As it shifts from one cell-end to the next, it leaves the sensitive cell center and passes over the blind edge before reaching the center of the next. The light sensation is interrupted and the star appears to twinkle. If the image could be held steady on a single cell-center, it would not twinkle, but the eye itself is never steady enough and even if it were, the moving currents of miles-thick air between us and the star refract its light beam most unsteadily, so that the star seems to be jumping around slightly. The old verse now reads

*Twinkle, twinkle, little star,
Now we know just what you are.*



WINTER COATS

With the coming of winter snows, several northern animals would find themselves conspicuous in dark coats of fur or feathers against the whitened ground were it not that nature had evolved a seasonal change of color for their protection. The Arctic Fox, for instance, changes its coat with the seasons, having a dark one to fit with the darker ground of summer and a white one to go with the winter's snows. As the fox hunts by stealth, the advantage of seasonal coloration is obvious. The stoat lives and changes color the same way.

Similarly, hunted animals such as the grouse, ptarmigan and mountain hare change color seasonally to help hide them from predacious enemies. The ptarmigan has even a third coat for autumn, with patches that break up its bird shape into shapeless blotches when viewed against any solid-colored background, dark or light.

Such an animal as the polar bear, living always among arctic snows and ice fields, keeps its white coat throughout the year and of course the animals of temperate zones have coats blending with the ordinary darker backgrounds. In any case, the coat habit acquired through evolution is that which gives advantage in the struggle for existence. Hunter and hunted alike gain by being inconspicuous. Natural selection does the rest.

CELEBRATE DARWIN ANNIVERSARY

"On the 12th of February 1809 two babes were born whose names are known to every school boy and girl in the land, Abraham Lincoln and Charles Darwin. The Colorado Rationalist Association will celebrate the 120th anniversary of this event the evening of February 12th, 1929.

Through the columns of your paper will you please urge other societies to do likewise. One of these men emancipated four million human beings from the chains of slavery, the other has emancipated millions of human minds from the ignorance and bigotry of the middle-ages. Is it not fitting that they should be remembered by the present age?"

O. O. Whitenack, Secy.

SHALL WE PUBLISH "THE PROOFS OF EVOLUTION" AS A PAMPHLET?

Dr. G. L. Howe, of Rochester, writes:

"Are you planning to publish in pamphlet form, 'Proofs of Evolution', concluded by Henshaw Ward in the November issue of EVOLUTION?

"This is by far the most clearly put and most conclusive thing along this line that I have yet seen, and I myself should like to have several copies in pamphlet form."

We agree with Dr. Howe that Henshaw Ward's "The Proof of Evolution" fills the bill for a pocket sized pamphlet, and shall publish it if there is sufficient demand. It would retail at 10c a copy, and come in hundred lots at not more than 5c. Advise us right away how many you'd take.

Twigs from the Family Tree

By N. K. MCKECHNIE

Millions of years ago a forest fire drove a family of our tree-dwelling ancestors apart. Most of them escaped over a mountain pass into a warm and hospitable forest land, where through the slow millenniums no need arose for them to modify the ways of living of their fathers. But two youngsters, who had become separated from the others, remained, and their progeny was modified by changing environment and climate. We are their final descendants.

A few months ago on an almost inaccessible mountain in the heart of Africa an old male gorilla roused himself from the bed on which he had enjoyed his afternoon siesta and looked about him.

He was an awe-inspiring figure, the very embodiment of brute strength. Four hundred pounds in weight, seven feet in height when standing upright, the heavy body hung with enormous arms dwarfed the bent mis-shapen legs beneath. It was the arms in fact that forced themselves most upon an observer's attention. These mighty limbs reached to below his knees and were muscled like a man's thigh. They could tear the body of a heavy-weight prize-fighter in two. Nay, were their owner muzzled so that he could not use his powerful jaws and put in a closed room with the twelve leading champions of the ring, not one of those twelve would leave the room alive. These arms of his like the rest of his body were clothed with long hair, black except on his back and chest, which presented a grizzled, almost silvery, appearance. His dark face was almost bare of hair, but from the top of his small head rose a stiff bush of black bristles that added to his apparent size. His eye-sockets were deep caves, his nostrils gaped flat and wide, and beneath them jutted his formidable jaws.

On rising from his couch of twigs and grass he had at first half squatted with bent knees, the knuckles of his hands to the ground, but now he raised himself to his full stature and with head thrown back sniffed the heated air.

Yes it was there again,—the man-scent! For two days now it had followed them, arousing always a vague uneasiness in his breast.

They must move again.

He gave a chuckling kind of call and immediately the rest of the band began to rouse from their lairs and assemble round him. Gravely he waited until all were present and then gave the word to proceed. The oldest female led the way, the others bearing their babies came next, then the adolescent young, and finally when all had disappeared in the dark tunnel of undergrowth, the old man himself followed.

For two or three hours the march pro-

ceeded, the females stopping occasionally on reaching an inviting open space, but always continuing at the word of their lord, until finally the sun had sunk low and he approved of a halt in a small clearing where numerous eight foot high clumps of wild celery promised abundance of food.

Then commenced the going-to-bed preparations. The younger members of the party were tired and peevish, and disinclined to subject themselves to the customary maternal ministrations. But their objections were speedily quelled by a few sound slaps and shakings quite after the fashion of a human mother and each youngster was gone over by the painstaking parental fingers, ears, eyes and nostrils carefully inspected and cleaned, and all burrs and thorns picked from their fur before they were allowed to ascend the tree that the old male had selected for their bed-room that night. It stood apart from others, so that no leopard or other tree-climbing enemy could reach the sleeping-quarters except by way of the main stem, and there at the foot the old man prepared his own bed. Autocrat he might be but he would give his life ere one of his flock should be harmed.

It was still light when the family were all established in their aerial beds and there was a considerable amount of unseemly noise among its younger members in spite of the efforts of the mothers to quiet it; but the old man at the foot of the tree gave an admonitory roar and smote on the trunk with his hand and the chatter ceased as though by magic.

Then the sun set and as suddenly fell the tropic night. The gorilla family slept, and if the slumber of the old male was continually broken (for he always awoke at the slightest sound) it was no remembrance of the ill-boding man-scent that disturbed his rest. Out of scent,—out of mind.

But down the backward trail in one of the clearings through which the gorillas had passed, a white man and his black boys had made their camp, and their watch-fire glowed dully on the encircling trees.

The next day having fed well on the luscious celery the old man gorilla was making up arrears of sleep while his family amused themselves at large in the bush that surrounded the clearing, when a sudden uproar brought him leaping to his feet. The white hunter and his party had stolen upon him up-wind, had pounced upon an eighteen-month infant wandering from his mother, and while three stalwart blacks by their united efforts were forcing the struggling, fighting, soft-furred creature into a capacious sack, the white man with a moving-picture camera concealed in a bush was eagerly reeling off foot after foot of film destined

to afford a few minutes entertainment to the sated inhabitants of the great man-cities from which he had come.

The old male glared around him. The wind, as we have said, was blowing from him to the men-folk and he did not sense their presence. But he saw the excitement of his wives and progeny, heard their danger signals and hastened towards what seemed to be the center of the disturbance. There some of the mothers were searching frenziedly for their infants, but others and a number of the older-youngsters were dodging about among the bushes peering over and through the foliage at a most unusual object visible at the margin of the clearing,—a white man who was waving his helmet to hold their interest while his black assistant hidden in the bushes cranked the movie-camera industriously.

The old male stopped astonished. Never had he seen anything resembling this. What was it? What did it mean? He, too, crouch behind a bush and stared at the mysterious apparition, his face wrinkling and twitching with curiosity.

But one of the females on the outskirts was more than excited; she was angry and in distress; she was clattering her teeth by rapid revolving motions of her hands beneath her chin. And a young male near her was endeavoring to alarm the intruders by sounding the war-drum, beating with his fists upon his immature chest.

The old man gorilla perceived them, moved in their direction, and as he went a strong whiff of the man-smell assailed his nostrils. Again the strange disquiet seized him, and with it anger at the persistence with which he had been pursued. He would drive them away. And raising to his full height he began to force his way towards the white man through the entangled bush, roaring like a lion, teeth-a-gleam, great fists causing his chest to reverberate like a drum.

Never before had such a spectacular advance failed of its purpose, but in this instance the enemy against whom it was directed did not quail. The white man stood his ground, and as the gorilla met his eyes a strange psychic force smote him, and for the first time in his life he feared. In futile vent for his emotions he seized a sapling, shook it passionately and with a single wrench tore it, roots and all, from the earth. Still the white man did not move. Still the mysterious emanations of human will impinged upon the gorilla's consciousness, benumbing his spirit, turning his heart to water. His universe was crumbling; in another minute he would have backed away, to have lived for ever after the slave of Fear.

And then suddenly among the trees he saw the dark forms of the negroes lugging the sack in which was the captured baby; he caught its scent; he heard its muffled cries;—and he came to himself again. All his,—shall we say "manhood"—surely that is not too high a term?—came back to him like a flood. Stronger than his fear of

Funnymentials



BER 19, 1928

No. 36

THE TERRIBLE CONSEQUENCES OF THE DOCTRINE OF EVOLUTION

Over and over again we hear the silly twaddle that it does not matter how we got here, whether by evolution or by direct creative act, but the important question is where are we going, what of the future? That sounds very well if it were not for the fact the Bible teaches that men FELL from a high and holy state or condition into sin and degeneration. If evolution be true, if indeed man evolved, developed from a lower order to what he now is and is still evolving, it follows that he did NOT FALL and not only is the Bible contradictory concerning the account of creation but it is contradicted when it says man FELL. DID HE FALL UP HILL? Was his fall an improvement? Bound to be if evolution is true. But hold. If man did not fall then he needs no Savior. If he needs no Savior then Christ died in vain and if Christ died in vain then all we have been saying about redemption and salvation goes for naught. All we have been saying about the new birth is foolishness. The blood of Jesus Christ is of no value. And that is not all. If evolution be true there is no such thing as a miracle and none of the so-called miracles by Jesus were real. He was just a mysterious performer, a juggler, and sleight of hand performer. And that is still not all. He was the real son of Joseph—God was not his father. Then it follows that Mary was an adulteress, a liar, and a deceiver for she committed adultery and when she got caught she lied to Joseph, her espoused husband, and said that God was the father of her child and silly old Joseph believed her lie and continued in that deception not knowing that Jesus was a BASTARD AND HIS MOTHER A BAWD! Evolution means all that. Shall such a devilish doctrine be taught in our tax-supported schools? Shall religious people be taxed to pay teachers to tell our children that JESUS CHRIST IS A BASTARD? If that is not an outrage what could be? If infidels and atheists want to teach such stuff as that let them do it at their own expense. We should enforce our evolution law to the letter. Everybody get busy.

NO PAPER CHRISTMAS WEEK

It is our custom to not publish a paper

death or of this spiritual force more fearful than death was his instinct for protection of those he led. With a mighty roar he hurled himself towards the ravisher of his family.

What was this deafening blinding explosion that smote him as he leapt? What was this sickening shocking blow that struck him in his very heart.—paralyzing his muscles,—loosening his knees,—bringing him crashing to the ground?

Before his wide-stretched eyes the sunlight turns to darkness, and wondering, still wondering, at the Mighty Power which has laid him low, his undisciplined spirit passes from fleshly ken.

The twins had met.

EVIDENCE OF DEGENERACY

In publishing under Funnymentials a photograph of a column from the front page of the Christmas number of the Baptist and Commoner, the paper that fathered the anti-evolution law in Arkansas, we do not mean to imply that all fundamentalists are of the degenerate type of mind of which that article is evidence. Many of them are noble and well meaning people, who simply don't know any better. But the hand that wrote that article is one of the controlling influences in the education of the children of Arkansas, and is now reaching out to dominate the teaching of science everywhere. Would you want that hand, and the type of mind that it reveals, to control the teaching of YOUR child? What are you doing to prevent it?

"THE MENACE OF DARWINISM"—

By WILLIAM JENNINGS BRYAN

64 pp., 12mo. Fleming H. Revell Co. 1922.

The cream of the late Mr. Bryan's pronouncements in reference to organic evolution can be found in this little pamphlet—"It is better to trust in the Rock of Ages than to know the Age of Rocks." Bryan occupies a position which is logically sounder than that of Price or O'Toole—he does not make any serious attempt to discuss the validity of the facts supporting the law of evolution, nor to assail any link in the chain of reasoning based on these facts, but regards an appeal to religious emotionalism as an adequate answer. "Having given Darwin's conclusions as to man's ancestry, I shall quote him to prove that his hypothesis is not only groundless, but absurd and harmful to society... He advances an hypothesis which, if true, would find support on every foot of the earth's surface, but which, as a matter of fact, finds support nowhere. There are myriads of living creatures about us, from insects too small to be seen with the naked eye to the largest mammals, and, yet, not one is in transition from one species to another; every one is perfect. It is strange that slight similarities should make him ignore gigantic differences. The remains of nearly one hundred species [sic] of vertebrate life have been found in the rocks, of which more than one-half are found living to-day, and none of the survivors show material change". Practically every statement in this quotation, explicit or implied, is untrue, as the author could have discovered by consulting standard works. "Is it not more rational to believe in God and explain the varieties of life in terms of divine power than to waste our lives in ridiculous attempts to explain the unexplainable." "Looking heavenward man can find inspiration in his lineage; looking about him he is impelled to kindness by a sense of kinship which binds him to his brothers. Mighty problems demand his attention; a world's destiny is to be determined by him. What time has he to waste in hunting for "Missing Links" or in searching for resemblances

between his forefathers and the ape?"

Mr. Bryan, then, is personally uninterested in science nor does he accept the validity of the scientific method. That is, he regards conclusions reached emotionally as inherently superior to those reached by dispassionate and painstaking thought. When he ventures into a discussion of facts, he is unable to be accurate. Mr. Bryan's position is probably not seriously inconsistent with itself, but between such a point of view and that of a real scientist, there is no point of contact.

HORACE ELMER-WOOD II.

AGAIN WE SAY: BOOKS

One of the principal reasons for publishing a journal like EVOLUTION is to interest people in the reading of good books. We invite every reader to make himself an instrument for the circulation of such books among friends. For this there is no "off season". It is always timely, always in order.

Below we list some books that have not merely momentary interest but permanent value. Take them off our book-shelf, and put them to work.

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"My opinion about the farce in Tennessee and Arkansas is that it will only stimulate the study of Evolution. All the ambitious youths and students will now dive into it and the actions of the fools in the different states will have one thing to their credit.

Gideon Penrod Marner, M.D., Kansas.

"We have had many fine reports in class by students getting their material from EVOLUTION.

I am teaching in a Methodist Denominational School in a Fundamentalist community and have poured evolution into the students as fast as I could feed it to them for four years and three summers. We had a modernist president but lately a change was made and a fundamentalist was appointed. Of course you know what happened without my telling you. Almost half of the instructors will not be hired for next year and I am looking for another position. The excuse for letting so many of us go was that the new president was going to economize by cutting out small classes but I notice that the liberals, materialists, and evolutionists are the ones to go."

Kansas.

(For obvious reasons we have omitted the name).

"The age-old quarrel between religion and science gets right down to brass tacks in Mount Vernon Washington, where a farmer is haled into court for refusing to allow the state to test his cows for tuberculosis. Such a test, the farmer asserted, was contrary to his religion."

Portland News, (Oreg.) Dec. 17, 1928

PITY THE HEATHEN

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In the March Issue

HOW BRITISH GUILF SCUTTLED THE AMERICAN NAVY—By Rear Admiral Bradley A. Fiske, U. S. N. Materialist!—Anti-Christian!—Jingoist!—shouts the mob as Admiral Fiske tells what he knows about disarmament. And he knows plenty—whether you agree with him or not! A sizzling article, this, that will start 'em talking—loud and long!

THE DISAPPEARANCE OF THE HOME—by Louis Bromfield Mr. Bromfield—who writes good books, even if they are "best sellers"!—gives us two startling pictures of what is humorously called the "home"—old and new. Prohibition, says he, did, of course, pull father away from the corner saloon—but it also sent the children to gin parties! And—now where are we?

THOMAS, SON OF GOD—By Carl Von Hoffman. An explorer and lecturer brings us, from darkest Africa, this fantastic, but true, story of a white man's religion, a native black man's mind, epilepsy and a desire for glory. Thomas, Son of God, follows a strange and bloody trail of evangelism.

WHO LAUGHS AT THE INSANE?—by John E. Lind, M. D. For 10 years in charge of the department for the criminal insane in a Washington hospital, Dr. Lind sees a gigantic and well-merited inferiority complex in those who laugh at the insane. Perhaps, we wonder, it's just as well to be half-witted as it is to be stupid.

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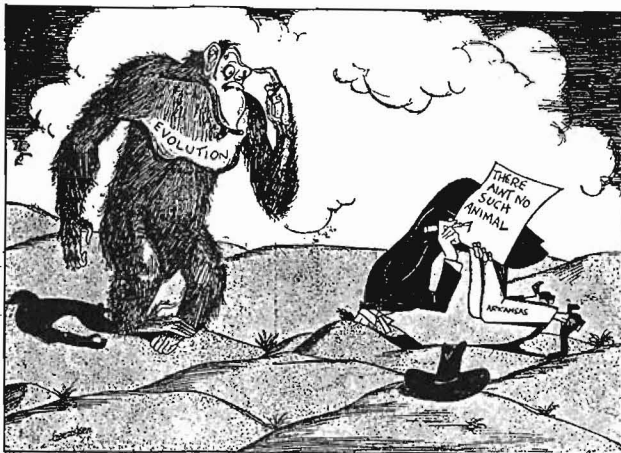
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EVL-39



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"We have been deceiving ourselves a long time in talking about the sacredness of majority rule. There is nothing necessarily divine or even intelligent about the opinion registered by 51 per cent or even more of those voting on a particular measure . . .

"No man outside of Bedlam would think of inviting a town meeting to vote on the question of taking out somebody's appendix or of prescribing the strength of materials to be used in a bridge. Yet evolution is far more complicated than surgery or bridge building . . ."

—From editorial in Collier's for Dec. 22, 1928.

THE GREAT DEBATE

EVOLUTION

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It is a Fact

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EVOLUTION

Entered as second class matter at New York, N. Y., Jan. 7, 1928. Evolution Publ. Corp., 96-5th Ave., N. Y.

GREAT SPIRAL STAR-CLOUD IN ANDROMEDA



250 Million-Billion Miles from End to End

New Worlds in the Making

By CLYDE FISHER

EVERYONE, after some observation of the heavenly bodies, begins to wonder at their origin. There is abundant evidence that the earth has not always been just as it is now. Even a superficial study of geology convinces one that the earth has a life story, if we can but read the record. And the more we examine the worlds outside of ours, the more we are persuaded that changes have been going on throughout the universe.

The first scientific theory of the origin of our solar system goes back to the philosophers Kant and Swedenborg. It was then developed and put into scientific form by La Place and became known as the Nebular Theory. According to this theory, the sun, all the planets and their satellites and the asteroids were once a huge, rotating, gaseous nebula, which extended out beyond the present orbit of Neptune. As this nebulous mass cooled, it contracted and its speed of rotation increased. This increase in the speed of rotation was accompanied by an increase in the centrifugal force by which a revolving body tends to fly from the center.

So it was with the outer part of this theoretical nebula. When this force had increased until it balanced the gravitational pull toward the center, the inner part of the nebulous mass contracted away from the outer rim. This rim was not thrown off like mud from a carriage-wheel, but was left balanced between gravity and its centrifugal force of rotation. This rim, which may not have been complete or even uniformly thick, was supposed to be collected together in a globular mass by the gravitational attraction of each particle for every other. Thus the outermost planet was first formed. In the same way the rest of the planets were successively formed, the one nearest the sun being the last formed. In the case of the asteroids, the tiny planets between the orbits of Jupiter and Mars, it was supposed that this rim gathered into more than a thousand small masses.

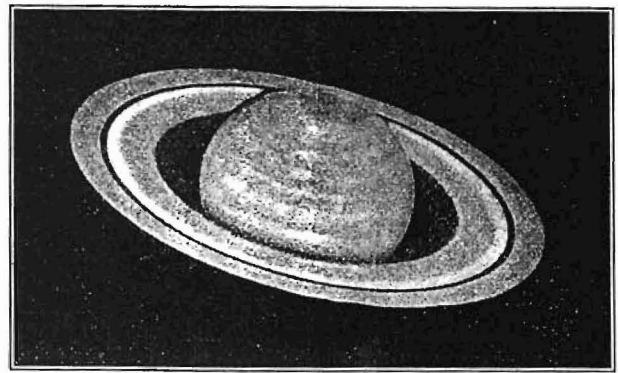
The moons or satellites of the planets were supposed to have been formed in the same way, after each planet mass had been left balanced between gravity and centrifugal force, and still revolving around the central portion of the original nebulous mass.

As the nebulous matter condensed and cooled, it changed from gas to liquid and then to solid, at least in the case of the four inner planets, Mercury, Venus, Earth and Mars. The four outer and larger planets, Jupiter, Saturn, Uranus and Neptune, still seem to present only an outer surface of cloud.

When the nebular theory was first conceived, it was thought to have two kinds of evidence in its favor, first, features in our solar system which the theory would account for, and second, systems outside our own now in phases suggesting the early stages of our own.

Evidence of the first kind was most impressive, for

it was thought the theory would explain the following conditions: 1) The planetary and most asteroid orbits are nearly in the same plane; so as to occupy a narrow belt in the heavens; 2) These orbits are nearly circular; 3) All the planets and asteroids revolve around the sun in the same direction; 4) The sun also rotates in that direction and its equator is but little inclined to their orbits; 5) The satellites revolve about the planets in the same direction in orbits nearly circular and nearly in the plane of each planet's equator (except two



Planet Saturn and Its Rings once thought to illustrate stage in evolution of Solar System

satellites of Jupiter and one of Saturn); and 6) The planets of the greater density are nearer the sun. If these relations were due to chance, we would have expected to find the planets and asteroids scattered over the sky and revolving around the sun or each other in many diverse ways. The conditions as they are point to a common origin and an orderly development.

The second kind of evidence, the phases in systems outside which suggest stages in the development of our own solar system, consisted largely of nebulae. No telescope is powerful enough to reveal planetary systems around any of the stars, even if they exist. The Great Nebula in Andromeda and that in the sword of Orion can be seen with the naked eye, and many more were discovered with the telescope. Sir William Herschel observed faint diffused nebulae, others in which a nucleus can just be discerned, and others in which the nucleus is a brilliant star-like point. And the spiral nebulae certainly appeared to be solar systems in the process of development. Larger telescope resolved some of the so-called nebulae into stars. At first this was thought to be fatal to the nebular theory, because of the natural conclusion that still larger telescopes might resolve the rest of the nebulae into stars. But the invention of the spectroscope proved that some nebulae were really gaseous and so re-established the nebular theory.

But in recent years, the nebular theory has lost ground. The spiral nebulae are now believed to be immense universes outside of our own galactic system. (*See front cover.*)

And present-day astronomers find two big difficulties. First "it can be proved that an extended tenuous ring would not condense into a single body, but into many bodies, like the asteroids or the rings of Saturn. Second, 98 per cent of the angular momentum of the solar system is at present associated with the orbital motions of the planets, comprising only 1/700th of its mass. The *total angular* momentum cannot be altered by any internal changes within the system, and no process has ever been imagined by which 98 per cent of it could have been segregated in less than 1/700th of its mass."

The nebular theory attempted to explain the origin of the solar system under the action of forces entirely within the system, but this is now believed by many astronomers to be impossible. The present distribution of angular momentum is believed to be due to forces from the outside of the system.

About twenty years ago Chamberlain and Moulton of the University of Chicago proposed an alternative theory which overcomes the difficulties. According to this theory, our sun in the remote past was a star without planets. Another such sun in journeying through space came so close to our sun as to cause a tremendous disturbance, pulling out great masses of

the sun and starting them on their revolutions. By a kind of explosion, due to the disturbance of gravity, myriads of these masses were projected into space, the so-called planetesimals. Not only was this new theory free from the fatal difficulties of the nebular theory, but it explained many features of the solar system and pointed to a common origin by an orderly process.

The myriads of planetesimals left revolving around the sun were slowly gathered together by the action of gravity into planets, satellites and asteroids. Perhaps meteors and comets are stray planetesimals.

The craters on the moon, some believe, were of volcanic origin, but there is much to favor the theory that they were caused by the impact of planetesimals or meteorites.

Among recent modifications of the planetesimal theory should be mentioned the tidal theory of Jeans and Jeffreys who agree in the encounter between our sun and some other star, but differ as to the dynamic details.

The age of our solar system, since the great catastrophe which started its development, is estimated with great probability to be from five to ten billions of years.

The Origin of Man from the Anthropoid Stem When and Where?

(From Bicentenary Number of American Philosophical Society's Proceedings, Vol. LXVI, 1927)

By WILLIAM K. GREGORY

IN his recent articles on the origin of man Professor Osborn rules the apes out of the line of ascent to man on the ground that they have ape brains and ape minds, that they have degenerate thumbs and limbs adapted for acrobatic life in the trees, that they walk on all fours and have grasping hind feet.

Anti-evolutionists of all schools are doubtless rejoicing in the fact that Professor Osborn has repudiated man's descent from apes and has brought forward with all the authority of his name some of the very points which they have long been stressing. But their exuberance will be dampened somewhat when they realize that Professor Osborn, like Professor Wood Jones, separates man from the apes only in order to derive him eventually from a *far lower* branch of the primate stock.

Out of all the confusing tangle of resemblances and differences between men and apes, opponents of Darwin's solution of the problem have regularly seized upon a few of the more evident differences, to which they have given wide publicity. But they have consistently ignored or depreciated the mass of positive marks of kinship visible in the very early embryonic stages of apes and men, as well as in adult anatomy and in profound physiological reactions.

This evidence as to man's kinship with the apes is always weakened by being cited in small quantities, since its logical value lies in its cumulative weight. The defender of the Darwinian view is truly at a

disadvantage precisely because his evidence is too extensive to be fully exhibited to his opponents. On the other hand, some who oppose Darwin's derivation of man from the apes imagine that they have raised serious objections to it, if they can cite even a few characters wherein modern man and ape differ.

Obviously there are many differences between man and the modern apes. If it were not so, there would either be no apes or no men and the problem would not now be under discussion. The first vital question is, are the characters, many or few, that are common to men and apes, due to inheritance from a more remote common stock, or are they due to parallelism? If the latter, if it still be admitted that man belongs in the order Primates, to what group other than the great apes is he most nearly related, by what steps has he diverged from that group, in what part of the world may we search for his ancestors and how shall we recognize such ancestors when we find them?

These questions in turn are quite obviously tied up with the general problem of the classification and geographic distribution of the families and subfamilies of the tree-shrews, lemurs, South American monkeys, Old World monkeys, apes and men, both recent and fossil. Since 1910 I have published a series of carefully worked out analyses of these problems, in which the Darwinian view of man's origin has been steadily upheld. The opponents of this view have not met the issues discussed in these papers. They have not

attempted a direct refutation of my arguments; they have not shown wherein I erred either as to facts or principles. They have simply made a flank attack by citing admitted differences between men and apes.

In these papers the evidence has been presented for the following outline of the history of the primates. By Basal Eocene times the primates were already in process of differentiation from the tree-shrew stock, which all authorities now regard as structurally ancestral to the primates. By Lower Eocene times we distinguish in both Europe and North America a branch which culminated in the modern *Tarsius*.

The structure of the hind foot is definitely known in the representatives of the Eocene families, as well as in all known recent and fossil lemurs, South American monkeys, Old World monkeys and apes, the hind foot having a widely divergent great toe, with a flat nail. Thus all the known palaeontologic, zoölogic and embryologic evidence supports the conclusion that from their first appearance the Primates as an order were thoroughly arboreal and that the terrestrial habits of the baboons and of man are a later acquisition. The early human embryo also retains the marked divergence of the great toe and even the adult human big toe retains the broad flat nail of arboreal Primates.

None of the lower groups—lemurs, tarsiods, South American monkeys—approach man except in obviously parallel features. They all stand on a distinctly lower plane and differ in many trenchant characters which are discussed in the papers cited.

The Old World series makes its appearance in the Lower Oligocene of Egypt. The most primitive known form, *Parapithecus*, is structurally intermediate between the stem of the tarsiods on the one hand, and the whole Old World series on the other. Although only the lower jaw is known, this highly important form must have had the shortened face and the swollen braincase, and probably the large eyes, of the small insectivorous tarsiods. Side by side with it is the oldest of the true apes, the lower jaw of *Propliopithecus haeckeli*. This has the dental formula common to the Old World monkeys, apes and man, but its lower jaw is deepened like that of the fruit eating apes and its molars already foreshadow the *Dryopithecus* pattern of the apes and man. It was plainly akin to the gibbons but smaller and more primitive. The eminent anthropologist Sergi has selected *Propliopithecus* as an ideal ancestor of man, but there is reason to believe that the human stem did not split off so far down the line. The modern gibbons have become specialized in the extreme length of their limbs and in the sabrelike form of their upper canine teeth, but they retain the hip callouses and other primitive features that ally them both with the Old World monkeys and with the anthropoids. According to Sir Arthur Keith's illuminating researches, the modern gibbons have already effected the profound readjustments of the internal organs necessary for the upright posture habitually adopted by the gibbon; this ape is no longer an arboreal quadruped but an upright-moving ape; its internal organs are actually far nearer to man than to the lowest of primates.

In the Miocene and Pliocene of India and Europe there was a wide spreading of the ape group, known, it is true, chiefly from teeth and jaws, some of which approach modern types. All develop the "*Dryopithecus* pattern" of the molars, the remnants of which are so clearly seen in man.

In the lower primates the principal axis of weight passes through the third or middle digit of the hind foot; such animals run upon the branches like arboreal quadrupeds. In the anthropoids the main axis of weight is shifted toward the inner side of the foot, in adaptation to the grasping habit. In the secondarily ground-dwelling mountain *Gorilla* the heel is broadened, the whole foot pressed flat upon the ground, the toes relatively shorter and the great toe relatively larger. In the human embryo of the ninth week the whole foot recalls the ape condition and differs widely from the adult foot, which doubtless for more than a million years has become thoroughly adapted exclusively for walking on the ground.

Sir Ray Lankester, knowing well only the more arboreal foot of the lowland *Gorilla*, endeavored to cast doubt on the evidence afforded by the more terrestrial foot of the mountain *Gorilla*, and clings to the belief that the peculiar construction of the human foot still constitutes a bar to the derivation of man from the anthropoid stem. Professor Adolph Schulz, on the other hand, has shown that during the course of its growth the human great toe is at first distinctly more ape-like and partly turned toward the other toes, but that as development proceeds it becomes twisted on its long axis so as to face downward, and is also drawn in toward the other toes. To transform a gorilla-like foot into a human foot, the big toe must increase in length and rotate on its own axis so that its surface shall be applied to the ground instead of facing toward the other toes. Next it would be necessary to shorten still further the toe-bones and to narrow the whole foot; that is, to make all the toes parallel, and the whole foot must be made to face downward rather than inward. One might also say that in order to transform an early embryo foot into the adult foot a number of changes are necessary; to enumerate these would be to repeat, word for word, the points of transformation of the foot of a gorilla into that of man.

The very fact that the great toe is the dominant one is strong evidence for the view that the human foot has been derived from an ape with a grasping great toe, for no other known primates afford such a favorable starting point for the human condition. Moreover, the muscles of the human foot show convincing evidence of special relationship to the anthropoid foot, as well understood from the time of Huxley.

In view of all this and of the fact that man is tied by so many other bonds to an order which was thoroughly arboreal in its first stages, the burden of proof would seem to lie upon anyone who prefers to maintain that the construction of the human foot constitutes a serious obstacle to the derivation of man from a pre-ape stem.

(To be concluded in our next issue.)

FREDERIC AUGUSTUS LUCAS

Dr. Frederic A. Lucas, director of the American Museum of Natural History from 1911 to 1923 and since then its honorary director, died at his home in Flushing, Long Island, on February 9th at the age of 76. He was buried at Plymouth, Massachusetts, where he was born March 25th, 1852.

He specialized in zoology and was an outstanding authority on ancient animals. He held important scientific and administrative posts with the United States National Museum and the Brooklyn Institute of Arts and Science before assuming the directorship of the Amer-



ican Museum, and was a member of many learned societies.

Dr. Lucas was well known to the readers of *EVOLUTION* through his many popular articles on The Animals of the Past, which have been very widely appreciated. The editors are trying to secure the use of much other similar material which he had prepared before his death. To help carry on the work he did so well in his life of long usefulness is our idea of honoring this kindly gentleman of science who never found any trouble too great in helping to further the cause of popular knowledge.

Sea Serpents and Such

By FREDERIC A. LUCAS

LIKE the "Fossil man," the sea-serpent flourishes perennially in the newspapers and, although now mainly regarded as a joke, there have been attempts to place him on a foundation of firm fact. The most earnest M. Oudemans expressed his belief in a rare, huge seal-like creature whose occasional appearance in southern waters gave rise to the best authenticated reports of sea-serpents. It has been suggested that some animal believed to be extinct had really lived over to the present. The few waifs spared from ancient faunas and stranded on the shores of the present, such as the Australian *Ceratodus* and our common Gar Pike were used to sustain this theory. If fish of such ancient lineage are still so common, why may there not be a few *Plesiosaurs* or *Mosasaurus* somewhere in the ocean depths? We may, of course, "suppose" anything, but as no trace of these creatures has been found outside of their ancient strata, all probabilities oppose the theory. But had these creatures been spared, they might well have passed for sea-serpents, even though *Zeuglodon*, the most serpent-like in form, was not a reptile at all.

Zeuglodon, "the yoke tooth," named from the shape of its great cutting teeth, was a strange animal, with four feet of head, ten feet of body and forty feet of tail, with body vertebrae of moderate size, but with those of the tail fifteen to eighteen inches long, the longest known for the bulk of the creature and weighing in the fossil condition fifty to sixty pounds. The tail obviously wagged the dog. The animal was fifty to seventy feet long and not more than six or eight feet through the deepest part of the body; the head was small and pointed, the jaws well armed with grasping and cutting teeth, and just back of the head was a pair of short paddles like those of a fur seal. Its articulations point to great freedom of movement up and down. This may mean it was an active diver, descending to great depths to prey on squid, as the *Sperm-Whale* does today, and that it could rear a third of its great length out of water for a wide view of its surroundings. If size indicates power, the great fluked tail was capable of propelling the beast at twenty to thirty miles an hour, a speed needed for the small head to provide food for the great tail. Or it may be that the inability to do this was the reason why *Zeuglodon* became extinct. On the other hand, the huge tail may have served to store up fat to be drawn upon when food became scarce.

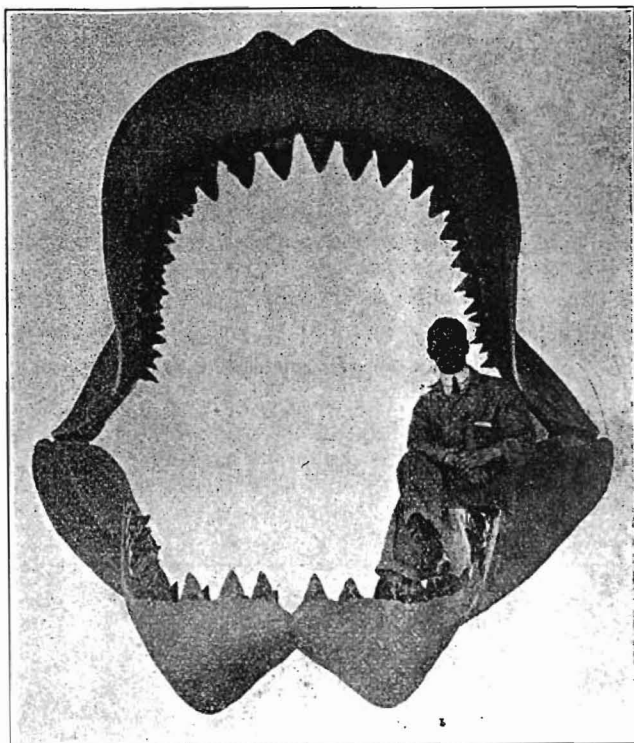
*Zeuglodon*s were numerous in the old Gulf of Mexico and seas of southern Europe, for bones are found abundantly. But common though the bones may be, the stories of their use for making stone walls resolve themselves on close scrutiny into the occasional use of a big vertebra to support the corner of a corncrib.

Its scientific name is *Basilosaurus cetoides*, the whale-like king lizard, given it by the original describer, Dr. Harlan, who thought it to be a reptile. The rule of science is that the first name given an animal may not be changed, even by a zoological congress, so *Zeuglodon* must masquerade as a reptile for the rest of its paleontological life. Owen's name "*Zeuglodon*," though not scientific, is too good to waste, being easily remembered and readily pronounced.

Dr. Albert Koch, doing with *Zeuglodon* as, later on, he did with the *Mastodon*, combined the vertebrae of several into a monster 114 feet long! This he exhibited in Europe under the name "*Hydrarchus*," or water king, finally disposing of the composite creature to the Museum of Dresden, where it was promptly reduced to its proper dimensions. Its natural make-up is sufficiently composite without any aid from man, for the head and paddles are like those of a seal, the ribs like those of a manatee, and the shoulder blades precisely like those of a whale, while the vertebrae are different from those of any other animal. There were also tiny hind legs tucked away beneath the skin, but these were unknown until Mr. Charles Schuchert collected a series of specimens for the National Museum, from which the entire skeleton could be restored. Unlike ordinary fossil bones which break indifferently in any direction, those of *Zeuglodon* are built of concentric layers, like an onion, which tend to peel off during the preparation of a specimen.

As the wheels of time and change rolled slowly on, sharks again came uppermost, the warm Eocene and Miocene oceans fairly teeming with these sea-wolves. There were small sharks with slender teeth for catching little fishes, larger sharks with saw-like teeth for cutting slices out of larger fishes, and sharks that might have swallowed the biggest fish of today whole. We know these monsters mostly by their teeth, for their skeletons were soft cartilage, the absence of their remains being the reason these creatures are passed by while the adjectives huge, immense, enormous are lavished on *Mosasaurus* and *Plesiosaurs* that the great-toothed shark, *Carcharodon megalodon*, might well have eaten at a meal. For its gaping jaws with hundreds of gleaming teeth must have measured not less than six feet across.

Our great White Shark, the man-eater, attains a length of thirty feet, and a man just makes him a good lunch. One of his teeth is an inch and a quarter long, while a tooth of *Megalodon* is commonly three, often four or even five inches. This would indicate a shark 120 feet long, bigger than any whale, to whom a man would be just a mouthful to whet his sharkship's appetite. Certainly it was at least seventy-five to one-hundred feet long, quite large enough to make bathing in



Jaws of Giant Fossil Shark.

the Miocene ocean unpopular. Megalodon and a contemporary and closely related species that originated with him in Eocene times may have had something to do with the extinction of Zeuglodon. This second species has a little projection at the base of the cutting teeth, like an "ear" on a jar, so that it is named *auriculatus*, or eared. The edges of its teeth are also more saw-like and with its length of fifty or sixty feet and better armament, it must have been most formidable. The supply of teeth never ran short, for back of each tooth in use lay a reserve of six or seven smaller but growing teeth ready to replace each front tooth lost and, like a well-trained soldier, to keep the line unbroken.

Once fairly started, these huge sharks swarmed everywhere that the water was warm enough, for their teeth occur in Tertiary strata in many parts of the world, and the deep-sea dredges of the Challenger and Albatross brought them up by scores. And then they perished utterly. Why? We do not know. Did they devour everything throughout their habitat and fall to eating each other? We do not know. But perish they did, while the smaller white shark lives on, as if to prove that it is best not to overdo things and that victory is not in the long run always to the largest.

The Anthropoid Apes

By EDWARD GRIEG CLEMMER

This is the first of a series of four articles on The Ancestors of Modern Man by the same author. The next will be on The Earliest Men.

THE living anthropoid, or man-like, apes are four in number, the gorilla and chimpanzee of Africa, and the gibbon and orang of Asia. Their near relationship to man is proved beyond reasonable doubt by comparative anatomy.

The gibbon is generically the lowest. It usually stands about three feet tall and has the longest arms in proportion to the body in the family. The arms are so long that the hands reach the ground even when the gibbon stands erect. Its natural habitat being in the trees, it does not seem to know what to do with its arms when it is forced to walk on the ground. In such circumstances it may rest the palms of the hands downward on the ground or raise

the arms above the head. But in the trees the gibbon uses his long arms to advantage, swinging and leaping twelve to fifteen feet in a single jump. His arms have undoubtedly been lengthened by this necessity of his environment.

The Orang-utang, found in the woods of Borneo and Sumatra, stands second in the anthropoid scale. Indeed, the name in Malay means "Man of the Woods." The orang is usually about four feet in height and very bulky, measuring in circumference two-thirds its height. The arms are very long, reaching a spread of seven feet in an adult male. It is not as adept at arboreal life as the gibbon, but climbs deliberately as if not really used to such hazards. Yet he is not a slow traveller, for he can make as much time in the tree tops as a man on the ground.

The chimpanzees are the most interesting of the apes. They are found in equatorial Africa and are much less arboreal in their habits than the orangs. When they walk on the ground they assist themselves by touching their knuckles, being unable to walk upright more than a few feet.

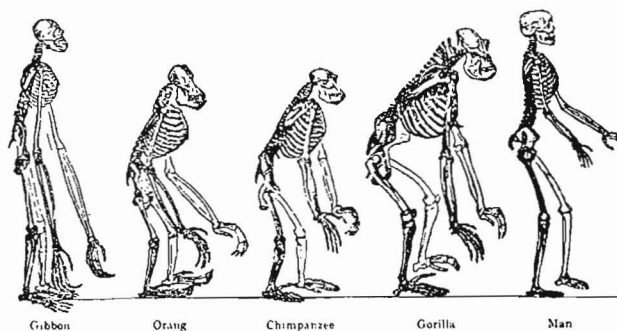
They are the most intelligent of the apes and can be taught to do many things a human being does. They can learn to eat in a civilized manner, dress in modern clothes, smoke and ride a bicycle. They take pride in their bag-full of tricks and have some capacity for performing original feats. The young are docile, but with puberty their temper changes and it is not safe to give them free rein thereafter. Many a young chimpanzee has delighted an audience with his mischievous and original performances.

In the minds of most people, the gorilla is the bizarre member of the family. This is on account of his great size and the tales of his ferocity and human ways of "trapping" his victims. Carl Akeley has, however, exploded many of the gorilla myths. He found him very peaceful if left to himself, but once aroused, a formidable enemy. An adult male stands about five feet seven inches when erect and weighs about three hundred and fifty pounds.

The gorilla is not tree-dwelling. It sleeps in nests on the ground, not elaborately built, but made of any twigs and leaves within easy reach. It usually travels in a family of eight or ten, consisting of three or more females, several offspring and from one to four males. It never walks upright, but on all fours, leaning the body forward with the knuckles touching the ground. We have little knowledge of its intelligence, as captured specimens rarely survive.

Practically all the anatomical changes which distinguish man from the apes are due to two causes; the forced change from the arboreal to the ground life, and the development of greater intelligence in man. When man's ancestors descended from the trees to the ground, they found it advantageous to develop an upright carriage. This made for stronger calf and hip muscles and changes in the big toe. The upright position also changed the position of the head on the spine, and the long ape arms, not being needed on the ground, were gradually shortened, if they were ever really developed in man's early ancestors.

In spite of some differences which may seem wide, the fundamental structures of the apes and man are closely similar. Moreover, modern blood tests indicate their kinship. There can be no reasonable doubt, in the face of the mass of scientific evidence and the unanimous conclusion of the scientific specialists, that man and the anthropoid apes are blood cousins.



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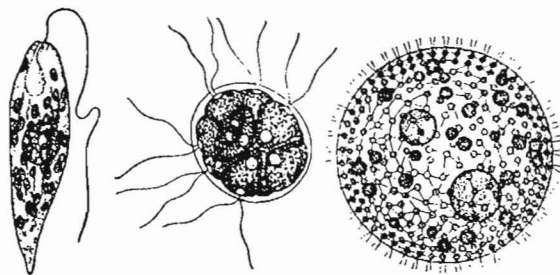
Plant Evolution

By FLORENCE DOWDEN WOOD

PLANTS have undergone as complete evolution as have the animals. There are three main lines of proof: 1) comparative study of existing plant forms; 2) specialization in reproduction; 3) fossil evidence. The lowest plants started out from a common stem with the single-celled animal. This single-celled organism, neither definitely plant nor animal, could not only digest food in the animal fashion, but could also manufacture its own food in plant fashion.

Any organism which can make food from the elements surrounding it, would seem ideal at first glance. Plants from the first, must have had this ability, but they have sacrificed the power of locomotion, as well as the possibility for a central nervous system to guide them to adequate sources of food.

In plants, as in animals, the tendency has been to grow larger and larger, as much so as possible in each stage of evolution, given the then existing degree of specialization for food manufacture and reproduction. When size alone is considered, plants have been able to attain that without much in the way of specialization, as is seen in the enormous sea weeds, some attaining a length of 600 or more feet. An additional barrier, before attaining the goal of the modern seed plant, is the lack of a satisfactory means of reproduction, as all primitive plants require water in which the sex products can swim to each other. In no case is there a mechanical means provided for getting the sex cells together, except as the cells themselves have the power of motion. The higher plants depend on wind and insects for pollination.



1. *Euglena*, the plant-animal. 2. *Pandorina*, free swimming colony. 3. *Volvox*, a large colony.

Assuming that we start with an undifferentiated "plant-animal" organism as the plant's great-grandmother, we must bring it up through the stages marked by the various levels of existing plants till we reach the highest type of seed plant. The first stage is *Euglena* (1). It is so small that a half dozen individuals can be put in the space of an "i" dot. The free-swimming plant-animal reproduces itself by simple division. In its eagerness to attain higher things, the new organism does not have time to separate completely from the old, resulting in a colonial form, the *Pandorina* (2) stage now barely visible to the naked eye. This colonial form has a tendency to grow larger. With further increase in size, there is too little economy of energy, and a new advance appears, a division of labor. Some cells are set aside for reproduction, while the rest manufacture food, and propel the organism about, as in the *Volvox* stage (3). The reproductive products, "eggs" and "sperm" in this stage are not essentially different in appearance from the original one-celled plant-animal.

Very soon this colonial form finds itself growing larger. It must then do one of two things, either remain small and free-swimming to avoid being broken apart by moving water, or to find a quiet place to sit down and grow. Having elected to lead a quiet life, the plant develops a set of "holdfasts," which resemble roots but do not function as such. These enable it to keep a firm grip on the rock or mud bottom of the water, as in the kelp or sea weed stage (4).

If the plant is to live on land, it must develop a system to get water, nitrates, inorganic salts, and CO_2 from its

environment, and be able to collect them together for chemical rearrangement into foods. Also, it must develop a system of reproduction which does not require water to bring together its sex products to produce a new organism.

A big advance is made in the moss stage of our evolving plant. It has overcome some of the difficulties of food absorption. It has new absorptive root hairs on what we may call the old "holdfast"; food elements can be taken in from the soil, while the rest of the plant can emerge from the water. This moss plant has assumed a new form. It now has a distinct root, stem, and leaf, each of which has a special function. The root absorbs food, the stem distributes it, and the leaves manufacture starch from CO_2 and water, by the help of the sun's energy. Each of these structures is exceedingly primitive in its form and function, but they are the foundation of the large terrestrial plant of modern times. The mosses have a handicap, however; they can never get completely away from water. They are obliged to keep within range of moisture in order to liberate their free-swimming sex products.

The fern stage is a distinct step upward. It has a distinctly improved conductive system, real leaves, real stem, and a real root. Its reproduction system is modified. The asexual cycle has attained great proportions, as seen in the tree ferns, and the sexual cycle, though not less important, has been reduced to a tiny moisture loving plant, small enough to allow the male sex cells to swim to the female cells, which have lost their power to swim about and leave the plant that produced them since the early moss stage.

The problem of getting away from a method of reproduction which is dependent on water as a medium of dispersal for its sex products is extremely difficult. The solution is at least attained in the production of a seed. At first the seed is naked and extremely primitive (Gymnosperms—palms, ginkgos and pines). In a still more advanced stage the seeds are more evolved and well protected. (Angiosperms—hardwoods, shrubs and flowering plants). The flower which produces the seed, together with the seed, contain the key to the success of the modern plants. The plant which started as a very lowly, rather undecided organism, has now achieved the ability to live entirely on land. The sexual and asexual cycles have been neatly tucked away in the small compass of the flower and seed. This remarkable evolutionary achievement has allowed the plant to devote a great deal of energy to the formation of complicated independent conducting systems for both manufactured foods and for potential food elements and water.

The support of larger and larger structure has been taken care of in the formation of great bundles of framework whose function is to maintain the rigidity of the plant, holding it upright. The cells devoting themselves to this task are a magnificent engineering achievement.



"Sea Palm with Hold-fasts"

The most imposing of the modern seed plants to-day are certainly the big tree and the giant sequoia. But for the highest attainment in evolutionary complexity, as well as in numbers now populating the earth, we must look to the less spectacular sunflower group (asters, goldenrods, dandelions, etc.). Our original one-celled plant reaches the pinnacle of achievement in a beautiful chrysanthemum.

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NUMBER TWELVE

This issue of EVOLUTION is our Number Twelve. Thus we complete our "first year." It has been a hard battle, and it has taken more than a year to do it, but thanks to the support of its readers and writers EVOLUTION is "carrying on".

We doubt that any magazine has had contributions from more noted and gifted writers during its first year than EVOLUTION. During the coming year we expect to have articles from the leading authorities in every field of science.

And we are sure that no journal as young as ours has a more active and enthusiastic body of supporters among its readers. We now have over five thousand paid subscriptions, and the number is growing steadily. This is being achieved through the volunteer efforts of our readers and without working capital except as raised from month to month.

A reasonable period of this sort of work, and EVOLUTION will be on a self-sustaining basis. Then we can undertake larger campaigns of popular education.

This popular education must be multiplied an hundred fold to meet the coming need. Wherever defeated in the legislatures, the fundamentalists are sure to "appeal to the people" through referendum as they did in Arkansas. And the only way to prevent them from winning similar victories elsewhere is popular education. This is the reason for the existence of EVOLUTION.

NO FEBRUARY ISSUE

To get the advantage of predating we once more skip a month by name, although we do not skip a number. We expect to mail EVOLUTION the last week of each month for the following month.

THE TEST OF TRUTH

Let us not forget that back of this issue between Evolutionist and anti-Evolutionist is that greater issue between Scientist and Fundamentalist, "What is the test of truth?" Is it agreement of opinion with observed evidence, or with alleged authority?

Your scientist tests his theory by its agreement with the whole body of observed facts of experience and experiment. He alters no fact to suit his theory and holds no theory as true in the face of a single, stubborn, discrepant fact, be it well authenticated and verifiable. He submits his formulated opinion to the test of fact as a matter of course and asks you so to test it. He claims for it no sanctity, no privileges, no immunity from examination, criticism and attack. He welcomes each new significant fact acquired and each restatement of theory in closer agreement with all known facts. He searches for such truth eagerly, is overjoyed to discover it and to proclaim his discovery, but he does not ask that it bear his brand, nor that he and his opinions shall be given unquestioned authority. Nor does he ask that truth be pleasant, nor flattering, nor according to previous bias. To the extent that he may permit his wish and bias to modify his opinions, he does not represent the spirit of science.

With your fundamentalist it is otherwise. He prejudices the theory. His test of its truth is its agreement with the authority he happens to accept. He claims that that authority is divine and sacred from examination, criticism and doubt. Ask him to prove the divinity of his authority and he reiterates his belief that it is divine, questions your moral character for doubting him, charges you with sacrilege and threatens you with the dire consequences due the faithless. He asks you to accept his opinion because he himself accepts it. He makes his own belief, that is to say, himself, the authority. Differ from him and his alleged authority and you are wrong, intellectually and morally—and, of course, lost. Agree with him and you are right and saintly and saved.

He claims that evolution is untrue because he does not wish a "brutal ape" for ancestor, just as his medieval fundamentalist forbears denied that the earth travelled about the sun because they did not wish the habitation of MAN removed from its central importance in their universe. The inconvenient evidence of biologic, geologic and astronomic facts he denies or ignores. He does not want free inquiry and unbiased teaching and discussion. He wants his opinion protected by law from doubt and criticism, and confesses his lack of real faith in it by his refusal to let it stand or fall on its own merits. He makes himself the sole authority on truth and then wonders and berates because others will not take him at his own measure. A. S. B.

THE GREAT DEBATE

The Great Debate between Rev. W. B. Riley and Prof. Joseph McCabe on the question "Resolved that Evolution is True and Should be Taught in the Schools," held in New York February 7th, passed off without bloodshed.

The stenographic record of the festivities, complete and verbatim, will be published in EVOLUTION, beginning with the next issue. We shall not anticipate the arguments, except to assure our readers that a real treat is in store for them.

The audience was overwhelmingly in favor of McCabe. The vote was at least ten to one for evolution. This was to be expected, since the followers of Stratton were most conspicuous by their absence, in the audience. However, they packed themselves in on the list of judges since inadvertently the "gate had been left open," so to speak, and there they voted for Riley by 17 to 12.

The most interesting decision was rendered by a group of 41 High School students, who were also seated on the platform to pass their own opinion regarding the debate. They voted 35 to 6 in favor of McCabe.

The favor of these young people, the approval of Youth, means more to Professor McCabe and EVOLUTION than the anathemas of all the fundamentalist preachers.

Our own judgement of the arguments presented is that nothing better can be done for the cause of freedom of teaching than to circulate the arguments made by Rev. W. B. Riley exactly as delivered in comparison with those of Professor McCabe. So we'll print them in EVOLUTION and depend upon YOU to get your neighbors and friends to read them.

GETTING INTO ACTION

The Science League of America is girding its loins for battle with the fundamentalists in the legislative halls. The call to action is printed in another column. Every evolutionist should answer it. This work of the Science League is absolutely essential to winning freedom of research and teaching in all the states.

IMPORTANT TO HUMANITY

By Professor F. A. E. CREW.

"What is more important to humanity... is the further extension and democratization of the evolutionary concept. It was this that overthrew medieval theology, and completed the enlarging of the mental horizon of humanity. Man's notion of himself has changed from that of a being originally created and awaiting a day of reckoning in a not too distant future, to that of a being originating as part of organic nature and set in a universe without beginning and without end. The intellectual revolution has emancipated countless men from the bondage of authority. It must free all.—From an article on "Biology and Education" in *Nature*, January 12, 1929.

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Scientists Act for Freedom

University professors and co-operating research workers plan action against Fundamentalists.

By BARROW LYONS.

THE first steps have been taken by men of science toward combatting the influence of anti-evolutionists, who have virtually succeeded in eliminating the mention of evolution from the biology text books used in the elementary schools of the country. At the fiftieth annual meeting of the American Association of University Professors held in New York over the Christmas holidays action was taken authorizing the appointment of a special committee to co-operate with the American Ass'n for the Advancement of Science to fight anti-evolution legislation and other efforts to restrict the freedom of the teaching of science. Whether this effort will get far beyond the resolution stage remains to be seen.

Meanwhile the World's Christian Fundamentals Association continues to circulate its list of books considered safe for young Americans and to bring influence to bear upon text book commissions throughout the country in effectively preventing the publication of comprehensive biology text books. At least, enough commissions have rejected books mentioning evolution to influence publishers.

The appointment of the university professors' committee was authorized in a resolution strongly "deploring" all restrictions on the freedom of teaching scientific subjects. It urged the preparation of a circular to battle for the freedom of teaching and to point out clearly the "great harm" of all anti-evolution laws and regulations.

The American Association for the Advancement of Science also "took action" by passing as a committee of the whole a resolution which declared:

"We are convinced that any legislation attempting to limit the teaching of any widely accepted scientific doctrine is a profound mistake which cannot fail to retard the advancement of knowledge of human welfare. It is only by the maintenance of freedom of teaching that we can create conditions under which truth comes most rapidly to prevail. Therefore, we wish to make our most earnest protest against all legislation and administrative interference with the presentation of the facts and theories of science."

That is a good beginning, but it is not likely to be taken as a serious menace to the morals and welfare of American youth by the Fundamentalists. It does not breathe militant determination on the part of scientists.

There is no question, however, about the Fundamentalists forming a militant, fighting group. Small as the number of their leaders is, they have made matters sufficiently uncomfortable for those concerned with the production and distribution of text books. They are unusually dangerous gentlemen to tackle.

They have caused the fall of more than one university professor, working quietly and under cover as often as by public ballyhoo.

Their strength lies in that they are moved by high moral endeavor, by the fervor which holds the glory of God above all else and leads them to heroic efforts to accomplish their ends. They believe themselves allied with the Deity and invincible. What school boards, what text book commissions, what publishers can stand before aroused righteousness of this sort?

And what have the school teachers of the country to offer against an onslaught of this nature? How can they bring the teaching of evolution back into the biology text books of the elementary schools? By what means can they make the judgment of science felt as against judgments colored by ancient superstitions?

That must be for teachers themselves to decide. I shall merely attempt to suggest some of the fundamental principles they must carefully think out, which must be generally agreed upon before there can be effective concerted action.

Thoughtful teachers for a long time have been asking who should be the authority as to what they should teach and where that authority should begin and end. On the one hand, it is evident that laymen unversed in science are incompetent to pass judgment upon fine points of scientific fact and theory. More and more the world relies upon the judgment of authorities and experts. But it is also evident that there must be some order and system in the curricula of public schools, where teachers are changing and pupils are being prepared for standardized courses of advanced education, the gateways to which are college entrance examinations.

Although requirements for secondary schools must be met in the elementary schools, and requirements for college must be met in the secondary schools, there is still considerable latitude for the teacher, if not interfered with by legislation or meddling school boards. Is it, then, sufficient to select the most competent teacher available and then leave it to him or her what to teach, or is the layman ever justified in prescribing details in the curriculum?

Another problem which teachers must face very seriously—and if they are not concerned there is no one else who will be—is that of the preparation of text books. As I pointed out in earlier articles of this series, some of the largest text book publishers admit that they print books for sale and not primarily for education or uplift. They are running large business; they are re-

sponsible to stockholders and must show profits. If they permit competitors to push them aside, they will show losses. Hence, they cannot afford to antagonize any considerable element of the community.

The principle is wrong. Text books should be printed for use and not for profit, for education and not to bring emolument to the shareholders of corporations.

It would be quite within the range of possibility for teachers to organize and operate a co-operative text book publishing house which would print science text books untainted by the influence of fundamentalism, history text books whose authors were free to tell the truth about the medieval church or the actions of our own forefathers which did not sidestep the rottenness in America, political science texts of American politics and economics, text books facing fearlessly the conflicts in contemporary productive organization.

The vitiation of science text books is merely the result of a thoroughly bad system which affects us in a thousand ways. It is through the perversion of the minds of young people, or at the best, keeping them in ignorance of a true picture of the world about them, that the system fastens itself most firmly upon the community.

Bigotry and intolerance flourish only where science is suppressed. Set free the teachers, put text books in their hands that tell the truth, and you have made a long step forward to a world rid of ancient superstitions and prejudices.

EVOLUTION ANNIVERSARY DINNER SATURDAY, APRIL THIRTEENTH

The charter of the EVOLUTION PUBLISHING CORPORATION is dated April 13, 1927. Last year this occasion was celebrated in New York and several other cities by Evolution dinners. This year we hope that Evolution dinners will be arranged in every city where EVOLUTION has readers, to celebrate the birthday of this champion of intellectual freedom and gather inspiration to carry to victory the struggle against fundamentalism.

Every reader with the necessary energy is invited to make arrangements in his community. Notify us of your intentions, and we'll wire you if some one has already started in your city.

Details, addresses where dinners will take place, hour and price, names of responsible managers, speakers etc. should reach us before March 20th for publication in April EVOLUTION.

All who arrange in time will receive message from New York dinner, and should send a message to be read at the dinner in New York. Let us make these simultaneous dinners a tremendous nation-wide demonstration in favor of The Open Mind.

Fundamentalism in England and America

By MAYNARD SHIPLEY

OUR British friends often take an attitude of pity and condescension toward us poor creatures harrowed by the inroads of Fundamentalist obscurantism. "How sad it is," they say in effect, "that science in America should have to contend with so out-dated a problem; and how fortunate are we in Great Britain that we have no such troubles here."

It would be fortunate, indeed, for English science if this assumption were correct. It is true, that there is far less open agitation against freedom of scientific teaching in their country and that that agitation comes from a group which has no standing culturally or politically. Also this struggle in which we are now engaged was fought and won three quarters of a century ago in England and even then it was a struggle between educated scientists and educated clergy; not, as here, between educated scientists and the fearfully uneducated clergy of the backward districts.

Nevertheless, the *World's* Christian Fundamentals Association was purposefully so named. From its start in America, it is already carrying its campaign to Europe. George McCready Price, the Fundamentalist "geologist," spreading his gospel of the Noachic flood and the literal interpretation of Genesis, for several years has been head of a so-called college in England. Aimee Semple McPherson, in her recent evangelizing tour in England, did not neglect to attack the teaching of evolution. And other American Fundamentalist evangelists are pledged to carry on the work in every English-speaking country on the globe.

At this very minute, in Bootle, Lancashire, a city of 80,000, it is against the law to teach evolution in the tax-supported schools. London is not all of England, and much anti-scientific propaganda is being "put over" in the smaller provincial towns and vast districts of Wales, Ireland, and Scotland, where people still believe in witchcraft, as firmly as our "Pennsylvania Dutch" towns where no hint of modern scientific thought has so far penetrated.

Mr. F. Gosling, a prominent British Rationalist, remarked recently in a private letter, "There certainly is an optimistic side to your conflict. Over here it is all so hidden, and though some comfortable people point to the tremendous advances made, I feel that the present rate of progress in the real enlightenment of the masses is too slow. Said comfortable ones are likely to pity America with her Fundamentalists, but seem to be half blind to the unconfessed Fundamentalism so prevalent here.... It may be that in a few years' time we shall be wishing to goodness that our Fundamentalists here would be fools enough to come out into the open."

Another English writer agrees, "We, in this country, also have our Fundamentalists, and they exist, if we include Ireland and Wales, in an even higher proportion than yours. They are, moreover, of a more dangerous type than are yours. They 'sap' where yours make noisy, frontal attacks."

Plenty of people in America still shout "Alarmist!" to those who point out the ever growing danger to which fanaticism and ignorance are exposing the teaching of science. The same type

of people take a similar attitude in England. But no one acquainted with that huge, semi-literate English sect the "Plymouth Brethren" and similar Fundamentalist groups can doubt that England also faces a real and increasing menace. England seems freer from anti-science threats not because she is really free, but because she is "next on the list."

In spite of the proud position of British science, and the real democracy and enlightenment of the better educated British thought, it may soon be necessary there, as it is vitally necessary here, to organize against the local manifestation of our common foe.

Activities of Science League

In November, for the first time in history, the initiative and referendum system was invoked, in Arkansas, to forbid the teaching of modern science. Nineteen other states have direct legislation, and the anti-evolutionists have announced that henceforth they intend to have recourse to this method whenever a legislature in one of these states proves "recalcitrant." Another phenomenon of 1928 was the appointment by the Florida State Senate of a committee of Fundamentalists to investigate and "purge" libraries of the State University and the State College for Women of scientific (particularly psychological) books not in accord with their theological views!

As we write, the 43 legislative sessions of 1929 are just opening. Already an anti-evolution bill has been introduced in the Texas legislature and killed by a close committee vote, only to be followed by another prohibiting teaching "contrary to the Book of Genesis." A bill to repeal the Tennessee law was promptly voted down, and a similar fate is anticipated for a like bill in Arkansas, though an anti-evolution enforcement bill there was indefinitely postponed. Dr. W. B. Riley has stated that he will again have an anti-evolution bill introduced in Minnesota, and definite threats of similar action come from New Mexico, Oklahoma, Colorado, Kansas and Montana. Before this report reaches you, several more states may well be facing anti-evolution legislation. Moreover, the "Defenders of the Faith," led by Paul Rader, have held a convention in Indianapolis, 100,000 strong, to arrange for anti-evolution activity in "48 nerve centers"—better known to us as the 48 secularly-governed states of the Union.

Educational and Defensive Work

Against this growing agitation, the Science League has continued its educational and defensive work to the limit of its resources. We have continued to act as a general information bureau for speakers, writers, and periodicals. In every state, up to and including Texas, where anti-evolution bills have been introduced, we have sent a strong protest brief, together with informative pamph-

lets, to the committee or the legislature, have asked our members in the states concerned to protest against the bills to their representatives, and have arranged for personal speakers against the bill if it should come to the floor. In Arkansas we worked through the local committee. We are now endeavoring, in case the repeal bill should be lost, to raise funds for a constitutional test of the Arkansas law, along lines which will not involve the martyrdom of a teacher. Incidentally, we have also been of help during the past year in securing new connections for several teachers who lost their positions because they taught evolution. Some of these cases occurred in states where no overt agitation has ever existed.

What You Can Do to Help

The demands upon us are increasing in far greater ratio than are the means at our disposal. The League is growing, but slowly; and the attacks on the teaching of modern science are growing much faster. Every member who is really heart and soul in this fight can be of great help to us if he will do one or more of the following: (1) tell his like-minded acquaintances about the League, and help us to build up the membership which alone provides our working funds; (2) keep his own dues paid up to date, and if possible become a life member (at the special rate of \$20 instead of \$25 extended to those already members); (3) send us names for circularization or distribute copies of our new leaflet, which will be printed in about a month; (4) send us prompt information and clippings relating to any new anti-evolution or similar activity in his own community; (5) contribute to the general or special work of the League; (6) help in the distribution of "The War on Modern Science," which tells the complete story of the anti-evolution crusade up to the summer of 1927, and has proved a startling eye-opener to many persons hitherto unaware of the situation.

Yours for freedom in research and teaching,

MAYNARD SHIPLEY, Pres.
Gillette Bldg., San Francisco.

The Amateur Scientist

A MONTHLY FEATURE conducted by ALLAN STRONG BROMS

The Constellation Orion

TO the south and right on the celestial equator you can easily identify the magnificent constellation Orion on these clear winter nights. It consists of an irregular quadrangle of four bright stars, marking the imaginary shoulders and legs of the mighty hunter of the Greek myths. From his belt (three stars in a row) hangs a glimmering sword of lesser stars. For his head there is a small triangle called Al Hakah, "the white spot," by the Arabs. In his right hand he wields an uplifted club and over his left arm carries a lion's hide for shield, both marked by groups of small stars.

At opposite corners of the great quadrangle are two stars of the first magnitude, at the northeast, red Betelgeuse, "the armpit of the central one" in the Arabic, and at the southwest, diamond-blue Rigel. At the northwest corner is yellow Bellatrix, the Amazon star, of second magnitude, and at the southeast a third magnitude star, Saiph. The stars of the Belt (from north to south) are Mintaka, Alnilham and Alnila, the first two white, the third yellowish.

Rigel, Mintaka and the brightest star of the head triangle appear double in the telescope, while Alnila is triple and the central star of the Sword quadruple. Even to the naked eye, this sword star has a strange shimmer. Viewed through an opera glass or small telescope, it is found to be surrounded by a faint nebula, the Greek name for cloud. Photographed with a large telescope and many hours exposure, this turns out to be one of the most beautiful objects in the heavens.

Mintaka and Betelgeuse are variable in their brightness. The latter is sometimes as bright as Rigel, at other times much inferior. Its variations are unpredictable, being quite irregular. Recent measurements at Mount Wilson Observatory with the great 100-inch telescope and by Michelson's new interferometer method indicate that Betelgeuse is nearly 250,000,000 miles in diameter or fifty million times the volume of our Sun. Its mass (weight), however, is only thirty-five times that of the Sun, for its density is very low, not much more than one-thousandth that of air. We would almost call that a vacuum. Its surface temperature turns out to be less than 3,000 degrees Centigrade, while that of the Sun is 6,000 degrees. While the Sun is white hot, Betelgeuse is merely red hot. Deep inside, however, the temperature undoubtedly rises to millions of degrees. It is probably a young sun just condensing from a nebula. As it grows older, its surface will turn white hot, its heat and even its substance will waste away and then, after billions of



The Constellation Orion

years, it will cool into a yellow star, then again red, and finally a dark star.

Rigel, with a diameter of 18,000,000 miles, over twenty times that of our Sun, and a surface temperature of 16,000 degrees, is at its evolutionary best. It would be about fifteen times as bright as Betelgeuse were it not three times as far away. The effect of distance on brightness is also well illustrated by a star to the southwest of Orion, the white Dog-Star Sirius, brightest of them all, as we see them. Actually, it is much inferior to Rigel and Betelgeuse in size and real brightness, but it quite outclasses them to us, because it is so very near, a mere matter of 50 million million miles.

YOUR BLIND SPOT

Try this experiment on yourself to find the blind spot in your eye. Close your right eye and read slowly with your left, being careful not to let it waver.

*—Watch the star disappear. If it does not, hold the page closer to your eye.

In the human eye the optic nerve enters the back of the eyeball, not in the center, but nearer the nose, so that in turning the left eye to the right at the proper angle, the image of the star falls on the spot where the optic nerve enters. As this spot is not sensitive to light, the star disappears.

The optic nerve, while capable of carrying nerve impulses that cause the sensation of light, is not itself sensitive to light. If it is injured, you do not feel pain, but get the sensation of flashes of light. If you feel pain at the

same time, that is because another nerve carries other impulses to a pain-sensing center in the brain.

The optic nerve ends within the eye as a spread-out layer, called the retina. This retina covers nearly the whole rear of the eyeball and is sensitive to light. But like all the rest of us, it gets tired and dull from overwork. As we use its center most, we can sometimes see better by using a fresher portion. For instance, if you want a glimpse of the Orion Nebula described in the neighboring article, just look a bit askance (away from the nose) with either eye. If the night is clear and moonless, and your eyes are good, you may be rewarded with a faint, brief view. In this way you reverse the blind spot experiment.

BROMS TO LECTURE

Allan Strong Brooms, our Science Editor, will deliver a course of five lectures on "EVOLUTION: From Stardust to Brain-Stuff" on consecutive Friday evenings, beginning March 8th at Union Auditorium, 229 West 48th Street, New York.

While these five lectures are intended primarily to interest the novice and enlighten the student, they will also be worthy of the science specialist because of the new material that will be presented. Readers need not hesitate to bring their most critical friends. The entire proceeds will be used for the promotion of EVOLUTION.

The subjects are announced on another page. Organizations in nearby cities that would like to arrange for this course of lectures should write for further details.

THE PROOFS OF EVOLUTION

The response to the question in our last issue 'Shall we publish 'The Proofs of Evolution' by Henshaw Ward as a Pamphlet' was so encouraging that we printed it immediately and are ready now to fill orders. The quantity price is fifteen copies for a dollar, five dollars per hundred. One of our readers has already taken five hundred, and several have ordered a hundred each. This little gem by Henshaw Ward promises to become a "best seller."

From Our Readers

"The value of all things, EVEN OUR OWN LIFE AND TIME, depends on the use we make of it."—A. Nielsen.

"I am called a modernist, but if there is anything that makes me inclined to become a fundamentalist it is your "EVOLUTION" Magazine. What corner of intelligence do you imagine you are cultivating? The cover of the January issue is typical of your mind. If you were really "scientific" you would not be crack-pated. Talk about "bigotry" of Arkansas. It is liberality de luxe compared with your narrowness." Elmer Wills Serl, Minister, The Church of Wide Fellowship, Southern Pines, N. C.

Premature Hosannahs

HOSANNAHS resounded in all the camps of the fundamentalists on the morning of January 21st when they read the Press dispatches from Washington, relating that Dr. A. H. Clark had renounced evolution and announced belief in the special creation of Man.

That these rejoicings were slightly premature is shown by the following comparison of reports:

First Report:

WASHINGTON, Jan. 20 (A.P.) Dr. Austin H. Clark, biologist, of the United States National Museum has propounded a new theory of evolution with revolutionary implications for biology and related sciences. He differs on vital points with the Darwinian theory of descent of man from a lower animal life and explains evolution as a series of jumps from one major form of life to another, rather than as a process of gradual development.

"So far as concerns the major groups of animals, the creationists seem to have the better of the argument," Dr. Clark said in announcing his theory. "There is not the slightest evidence that any one of the major groups arose from any other. Each is a special animal complex, related more or less closely to all the rest, and appearing, therefore, as a special and distinct creation."

The concept of Dr. Clark has man appearing on earth substantially as he is today, to all intents and purposes a product of special creation.

Dr. Clark sees no evidence of a "missing link," or intermediate form, between man and monkey.

Corrected Report:

(In New York World, February 3, 1929)

By DUDLEY NICHOLS

When scientific reports are constructed into news the results are only too frequently misconstructions, and that appears to have been the fate of the new theory of animal evolution proposed by Dr. Austin H. Clark a biologist of the Smithsonian Institute at Washington.

Perusal of Dr. Clark's thesis, now available in full in the Quarterly Review of Biology, indicates the error of the Fundamentalists in seizing the early news reports as weapons against the hated evolutionism. The very title of the biologist's paper is "Animal Evolution" and its aim is to propose an emendation, not denial, of man's concept of the evolution of present forms of life.

The paper may have been unfortunately worded, although it would never have been misunderstood by the biologists to whom it was addressed. Excerpts without the full text could be misused to stultify the whole report. The Associated Press dispatches from Washington, as printed in The World of Jan. 20, said, after quoting Dr. Clark:

"His concept differs with previous evidence of the descent of man from an apelike ancestor and asserts that man

appeared on earth substantially as he is today—to all intents and purposes a product of special creation. His theory is that man appeared in practically the same form he has today because of an inherent capacity of life to produce a variant, or 'abnormality', having an enormously enlarged brain in an environment where it was able to survive."

Definition Lacking

The writer is unable to find the remotest resemblance to such statements in Dr. Clark's own words.

What the biologist did propose was that "the creationists" appear to have the better of the argument so far as the "major groups of animals" are concerned. A more specific statement of what he meant by major groups would have made the matter clear. The explanatory diagram which accompanied the paper provides the necessary meaning, though it is also sufficiently expressed in the amplified text, and shows that Dr. Clark was referring to enormously comprehensive divisions of the animal kingdom. For instance the most complex group is composed of the vertebrata, and that comprehensive division contains all those animals with a backbone or segmented spinal column, such as the mammals, birds, reptiles, amphibians, fishes, etc.

These major groups to which he referred, and upon which his new thesis was focused, are enormously inclusive. The substance of his idea affects these groups alone, and he maintains that when once life appeared on earth, in its protoplasmic form, there were certain internal and external forces which led it to develop simultaneously along four lines and produce—i. e. create—the prototypes in all these groups.

In short, says Dr. Clark in substance, here were the building blocks for evolution. It was not just one humble cell, the amoeba, endlessly branching up like a growing tree, until it should blossom at the top in man. Instead that humble form immediately set off on a four way cosmic track to produce the few great group-forms of life, and the tremendous animal kingdom as we know it could then evolve from these basic forms.

Throw Off Variants

The biologist suggests that this process of evolution may not be so gradual as heretofore supposed, and he cites in corroboration some of the remarkable variations which species and sub-species tend to produce. A changing environment and inner forces as well might combine to throw off a remarkable variant, which could exist more easily than its progenitors, and so would multiply and supersede the original type, thus giving the appearance of a small jump in the evolutionary process. But that a man suddenly appeared full-brained, as the news despatches told, is too preposterous even to contradict. The biologists to whom Dr. Clark was speaking will

trouble themselves with no such chimera, but will question the data upon which he bases his theory that the prototypes of the few biological groups were products of a distinct creation. Even this last is but a thesis; that is, something laid down as a possible explanation of certain phenomena.

Before proceeding one might well inquire more closely into the meaning of these words, creationism and evolutionism. Philosophically, creationism is the doctrine that the world came into being out of nothing through an act of a transcendental Creator; that is a statement which science would not deny but only seek to interpret.

But commonly speaking creationism is the doctrine that distinct species of animals or plants were separately created, and Dr. Clark no more asserts that than he denies all science.

Limits Extension of Theory

His whole theory is focussed upon the creation of the major groups, and a species is, biologically speaking, but a small category of classification within a major group. A species is a category lower than a genus or sub-genus and above a sub-species or variety. All animals within a species may interbreed and reproduce.

While the idea of creationism is upheld by Dr. Clark for the major groups, he disposes of its extension by saying:

"But within each major group we see a very different picture. Here the fossil record shows a constant change from one horizon to another. These successive variations are probably simply indications of a direct response to physical alterations in environment favoring now one type or sub-type, now another.

"This continuous alteration in the elements within the various groups is what is commonly known as evolution. It is perhaps best illustrated by the vertebrates, since these are the most familiar of the animals.

"The evolution of the reptiles from the carboniferous to the end of the cretaceous, and of the mammals from the end of the basal Eocene to the present day, or rather to the Pleistocene period just past, forms a story of most absorbing interest. Here we can trace the gradual development from comparatively insignificant beginnings to a wonderful flowering of specialization and perfection. So much has been written on this subject, especially in recent years, that it seems unnecessary to pursue it further."

That sufficiently nails the notion of a specially and suddenly created man. As far as the layman is concerned, it does not alter in the slightest degree evolutionism as he is able to comprehend it. It leaves his evolutionary tree unaltered, except for some changes far down in the darker roots. There remains the imposing evolutionary tree of the vertebrates, with a minute ancient, worm-like creature at the bottom and the ten-fingered full-craniumed man at the top. What is new and important in Dr. Clark's paper can be intelligently weighed and discussed only by trained biologists.

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"THE BRAIN FROM APE TO MAN" by Frederick Tilney. Two volumes, 1120 pages. Paul B. Hoeber, Inc., New York. \$25.00.

This pair of imposing volumes, furnished with a wealth of illustrations, might well serve as a valuable weapon, either physical or verbal, in an encounter with a fundamentalist. It fills several distinct gaps. The principal new contribution is a detailed, technical description of the external and internal anatomy of the brains of the following primates: lemur, tarsius, marmoset, South American monkey, baboon, old-world monkey, gibbon, orang, chimpanzee, gorilla, and man, with special emphasis on the brain stem. This part of the work will be a valuable source-book for any one working on human evolution or the neurology of primates, but it must be admitted that these details are dull reading for the specialist, and totally incomprehensible to anyone else. The effective summaries of behavior for each of these forms will be much more to the taste of the lay reader.

The chapter on the internal casts of the brain case of fossil men and sub-men furnishes a valuable summary and comparative interpretation of the available data. It seems unfortunate that "Australopithecus" (the fossil progressive ape-child of South Africa) is omitted from this study. There are two chapters of popular resumé—"From Primitive to Modern Man" and "Man—Past, Present and Future." The discussion of the elements involved in brain progress among the primates is interesting and suggestive.

It seems somewhat invidious to dwell on defects in a useful and valuable work, but it would be disingenuous to deny their existence in this case. Various parts of the work vary in style from extremely popular to highly technical, and appeal to mutually exclusive audiences. Speculations as to the precise moment of the first appearance of the psyche will affect different readers in accordance with their own views on that topic. It seems an unnecessary bit of amateurishness to show comparative figures on discordant scales, without even a warning to that effect in the caption. Different meanings are given to the word "ape," some not in accord with general usage, and the reader is left to discover from the context in what sense the word is employed in each particular instance. Professor Tilney finds the brain of the gibbon more suggestive of the old-world monkeys than of the great apes, which is of considerable interest and importance; but it seems unfortunate on this account to call it an "intermediate primate," and "monkey," to the certain bewilderment of the general reader. It should be made clear that the assumption (by no means confined to Professor Tilney) that the great apes and possibly man also, have reached the end of their evolutionary

possibilities, is purely an assumption, with no positive evidence whatever in its favor.

Tilney follows Osborn and others in suggesting that the complete absence of evidence of race mixture between the Cro-Magnons and the Neanderthals was due to high moral principles or else to something analogous to "drawing the color line." It is surprising that the obvious alternative explanation of physical sterility between two widely separated species seems never to have been offered.

If Professor Tilney could write as good a book as this it is perhaps regrettable that he did not write a still better one. In any case, the evidence that he marshals furnishes still further evidence, if such be needed, of man's close resemblance to, and kinship with, the anthropoid apes, especially the chimpanzee and gorilla.

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And doubtless will for many ages.

But having got that story told
The scientists become more bold
We hear from Doctor Elliot Smith
A tale most eloquent, the pith
Of which is just that he and you
Are both descended from a shrew:
A nasty tempered little shrew!

Worse than an ape, if that be true.
And then from Africa there looms
This theory of Robert Broom's,
Whereby our ancestry is led
Back to the ancient Karroo bed
To primitive reptilian fonts
In horrid old Theriodonts!

It's bad enough to have an ape
For ancestor, but you could do
Much worse, for now we have a shrew
To head our family tree, or place
A crawling reptile for our race
To worship as our ancestor
Our deified progenitor!

But now the scientists with pep
Have taken still another step
And Doctor Gregory insists
We place on our ancestral lists
Some ancient fishes primitive
That in primeval seas did live.
A clumsy, awkward, slimy fish,
Not fit to serve upon a dish!

Then Doctor Stensio will trace
The fishes to an earlier race
Ostracoderms with names so shocking
You can't pronounce them without
choking.

And next the scientist will find
The evolution of our kind
Goes back to arthropod or worm
That in the Cambrian slime would
squirm.

Oh must this be, my learned friend?
My geneology to end
In writhing worm—whose better fate
Is use as Presidential bait?

Oh come! let's stop it at the ape
At least he's got some human shape.
W. D. Mathew.

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"Deal first with the only authority who knows all the facts. Approach His utterances by faith. Marshall facts to support His conclusions, which have first been accepted by faith. Draw justifiable conclusions from the available facts. If these conclusions do not harmonize with that which has been accepted by faith, hold the faith boldly and seek and wait for more facts."—*The Watchman Magazine*, February, 1929.

"We had better let our children suffer from disease, even die of neglect, than to permit them to be poisoned with that doctrine of the devil called evolution." Rev. Ben Bogart, Pres. American Anti-Evolution Ass'n, quoted by St. Louis Post Dispatch, Dec. 11, 1928.

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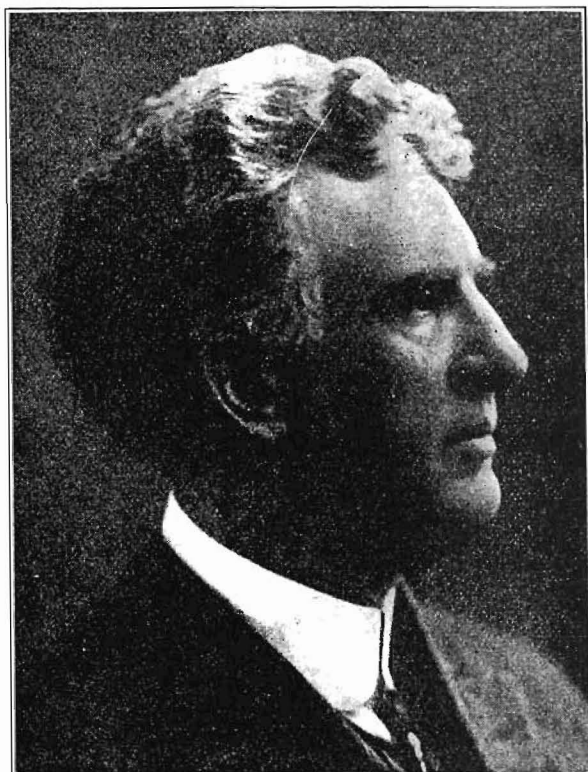
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Entered as second class matter at New York, N. Y., Jan. 7, 1928. Evolution Publ. Corp., 96-5th Ave., N. Y.

In this Issue—

RILEY—MCCABE EVOLUTION DEBATE

(Stenographic Record)



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McCabe-Riley Evolution Debate

MECCA AUDITORIUM, New York, Feb. 7, 1929

The Debaters:

PROF. JOSEPH McCABE, of England, *World's Greatest Popularizer of Science.*

REV. WM. B. RILEY, *President, World's Christian Fundamentals Association.*

The Chairman:

JUSTICE JOHN FORD of the New York Supreme Court.

The Subject:

RESOLVED: *That Evolution Is True and Should Be Taught in the Schools.*

In opening the meeting, Mr. Allan Strong Broms, Science Editor of EVOLUTION, made the following explanation: "There will be two official decisions, one on the question itself by the audience, the other by a group of judges upon the stage on the merits of the debate. There will also be an unofficial canvas of a group of high school students who are present, to find out how they re-act to the evolutionary and anti-evolutionary arguments, a very vital question tonight." He then turned the meeting over to the chairman of the evening, with the injunction to "make the combatants behave."

THE CHAIRMAN, JUSTICE JOHN FORD:—Ladies and Gentlemen, as I conceive it, we are here to find out from the arguments presented, and from nothing else, upon which side the weight of the evidence lies. You should put the pros and cons as you find them stated by the debaters, and vote accordingly no matter what your personal views may be upon the subject. That is only fair play for the debaters.

The debate will be opened by Professor McCabe of England, who will speak for twenty minutes in favor of the proposition, followed by the Reverend Dr. Riley, who will speak twenty-five minutes in the negative. Then Mr. McCabe will speak twenty minutes and Dr. Riley twenty-five minutes; Professor McCabe closing with five minutes. Then the judges will vote and you will vote.

I have now the great pleasure and the honor of introducing to you Professor Joseph McCabe of England. (Applause.)

PROFESSOR JOSEPH McCABE:—Our chairman, no doubt, feels quite at home in this court tonight, but I wonder whether he ever presided over a case in which all the expert witnesses in the world were on one side. I submit to you, first of all, that unless my opponent produces an expert witness—that is the situation you confront tonight.

I want you to understand clearly from the outset the respective positions of my opponents and myself. I am not a man of science. I am but a humble interpreter of science to the general public. And my every word tonight will have behind it the unanimous assent of all the scientific experts in the world. My opponent represents the minority which, unless he produces some new authority's name tonight, does not include one

single professor in the fifteen branches of modern science which are concerned with evolution.

You are, therefore, in listening to Dr. Riley, not listening to an interpretation of a body of experts. You are listening to him posing as an expert, alone, against this unanimous testimony of all the scientific experts in the world on a scientific subject. He has only a few clergymen, one or two medical men, and one or two teachers in religious colleges in America.

This would hardly be an issue to be debated if it were not for the grave situation that has arisen in America.

It is for you of New York to ascertain why whole States in this great Republic have been pledged to exclude from their schools a doctrine which all the scientific experts in the world regard as the most solidly established doctrine of modern science, and the most illuminating idea that the modern man of science uses in his researches.

I need only outline for you those evidences which have convinced all the scientists in the world that evolution is true. I will try to give you a very simple and clear, intellectual outline because I invite you to pass an intellectual verdict on this debate.

Look around the universe and most particularly this earth of ours. For ages we have wondered about the different animals and plants found in different regions. Why have you no lions and tigers in America? Why have you no elephants and camels in America? Extend that over the whole world. What is its meaning? What was the agency distributing the animal and flower population of the globe?

Men of science tell you that there is only one possible interpretation of the actual distribution of living things on this earth. From the centers in which they were evolved they spread right and left as geographical conditions permitted.

I ask my opponent to suggest some other agencies of the distribution of the animal and plant population. I ask him to explain why this distribution coincides in every single detail with what would occur if those animals and plants had come forth by evolution.

I will only give you one illustration on that point. The geologists tell us that millions of years ago New Zealand was split off from the rest of the globe. Geology shows that at that time no animal existed in the world higher than the reptile. What is the present population of New Zealand? Except for animals or plants that can float or fly, there is no native animal in New Zealand higher than the reptile, and that reptile is the most primitive known on this earth. I ask Dr. Riley to explain that.

The geologists tell us that Australia was cut off from the rest of the world at a certain time. The evolutionist finds that at that time there was no animal in the world higher than the kangaroo. There is no native animal in Australia higher than the kangaroo, except such as could float or fly from another region.

(Continued on Page 12)

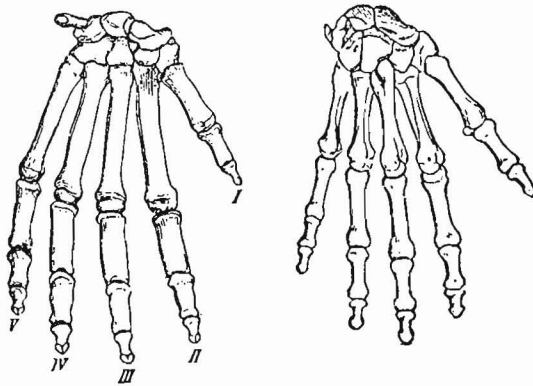
The Origin of Man from the Anthropoid Stem

When and Where?

(From Bicentenary Number of American Philosophical Society's Proceedings, Vol. LXVI, 1927)

By WILLIAM K. GREGORY

THE reduction of the thumb in apes is cited by Professor Osborn as ruling them out from the line of human ascent. But the remarkable feature is, not that apes should have the thumb reduced, but that they should have a thumb at all. No one can doubt, after inspection, that the Chimpanzee has a true hand and not a mere forefoot like that of four-footed animals. (See Figure 1, January EVOLUTION.) Who can now doubt that the thumb of man has not only increased the size but also improved its ability to oppose the other fingers. Professor Schultz states: "In early



Hand Bones of Man and Chimpanzee

fetal life the free thumb branches from the palm immediately at the base of the index finger. In the course of growth this place of branching shifts to a place nearer the wrist. . . . This movement of the thumb, away from the other fingers has greatly facilitated the opposability of the thumb. . . . The opposability of the thumb, which was . . . of greatest importance for the evolution of man, was not yet a feature of the original primate hand. It is significant, but not surprising, therefore, to find that this condition is still lacking in the human embryo. Not only does the embryonic thumb branch at a place unfavorable for effective opposability, but it is not yet rotated around its longitudinal axis to face the other digits."

While the human thumb passed from a stage where it was more nearly parallel to the other fingers to a stage where it can oppose them, the great toe developed in the opposite direction from a stage where it tended to face other toes to a stage in which it parallels them.

It may well be true that apes have ape minds and ape brains, adapted to life in the forest, whereas the Dawn Men (of Java, Pliocene, etc.) had definitely human minds and brains which for thousands of generations had adapted them for life on the plains. But this only establishes the fact that apes and men are different and have been different for a very long period of time. It does not throw any light on the questions

whether or not man is an offshoot from the ape stem, what that stem was like, and during what geologic epoch the separation occurred. If we hold with the anti-evolutionists that the human mind has not evolved out of any animal mind, then the labors of the comparative psychologists and neurologists are in vain. But if we accept man as a member of the order Primates and a derivative of some form of pre-human primate, then the evidence of comparative psychology must be taken into account.

What then is the testimony of these comparative sciences? From the labors of Koehler, Kohts and Yerkes it may be asserted that, although far below man in mental ability, the apes are unquestionably much nearer to man than are any of the lower animals of which the mentality has been carefully tested. Indeed, Yerkes, a most cautious and conscientious investigator, finds in the apes more than the rudiments of human thinking. And on the side of the "Dawn Men," Dubois, Elliot Smith, Hunter, Tilney, McGregor, point out the distinctly inferior development of the *Pithecanthropus* (Java man) brain as compared with the brain of modern man, in respect to the filling out of the critical areas which, from clinical research and other lines of evidence, are believed to be the seat of the higher mental faculties. The *Pithecanthropus* mentality then, while coming within the limits of the human family, was, so far as the brain cast indicates, by no means lacking in lowly traits.

Opponents of the Darwinian view should never refer to the comparison of the brains of apes and man, for there is nothing that so fully testifies to the relatively close kinship of man to the gorilla and chimpanzee, as the field of comparative neurology. The utmost efforts of anti-evolutionists have only brought into clearer relief the basic correspondence in all parts, not only of the brain surface, but of the brain stem of gorilla and man. The ape brain, according to the well-seasoned conclusions of Elliot Smith and Tilney, carries the line of evolution from the lower primates to a definitely sub-human stage. Doubtless the orang is a side specialization in some features, but the gorilla brain stands especially near to the primitive human brain.

All this is in full accord with the evidence from other sources, that the human stock derived a rich heritage from tree-dwelling ancestors, which, while fully erect in posture, avoided the extreme specializations of the existing apes and abandoned the trees before the thumb was greatly reduced or before the body was as heavy as that of the gorilla.

If man is not derived from the primitive ape stock, and yet is to be classed in the order Primates, from what other group did he spring? The tailed monkeys

of the Old World are sharply distinguished from the apes and man by their cheek teeth, which definitely place them as a specialized side line. They also retain the primitive condition of the hind feet, in which the main axis of weight passes through the third toe, whereas in the apes and man it has been shifted to the inner side of the foot. Professor Boule has suggested that perhaps man separated from the Old World monkey stock before the lengthening of the arms and the shortening of the legs in the modern ape group; but in view of the profound agreement of man with the apes in brain characters, blood tests and fetal development, a definitely pre-ape derivation of man lacks substantial evidence. The principal objection of deriving man from a point far down the primate tree is precisely the lack at that early stage of the very numerous characters which connect the human stock with that of the apes.

If the numerous converging lines of evidence for Darwin's view carry conviction to our minds, the next question is, when and where did the separation take

place? As to the time when, the separation must plainly have been before Mid-Pliocene times. The preceding millions of years during which the apes were branching out would seem to allow sufficient time for the accelerated evolution when a marked change in food habits, consequent upon the invasion of the plains, caused a higher instability in the ductless gland system. If man is so derived, there is added reason to search for his early representatives in some region of open plains, not too far removed from the ancestral forests of the conservative apes.

Thus, as to place where the human stock began to separate from the primitive chimpanzee-gorilla group, we can reasonably expect to find it somewhere within the known range of the ape group in the Miocene and Pliocene periods, that is, somewhere between Western Europe and Eastern Asia. Here we may refer to the excellent analysis of this question by Grabau and Black, who indicate the region of the Tarim desert in Turkestan as the most likely place in which to renew the search.

Brains—How Come?

By ALLAN STRONG BROMS

VI

THE brains of man, ape and monkey are alike in shape and working parts. These near relatives of ours look even more alike inside their skulls than outside. Man has put in some recent improvements, but the ground plans are the same.

Viewed from the side, the human front brain looks like a wrinkled boxing glove with padded thumb and knuckles. From above it looks like the fat kernel of a walnut, in two halves and all crumpled up. But it's not a "hard nut" nor solid, its gray working surface being quite soft and thin.

Mapping the working parts of the brain is simple in

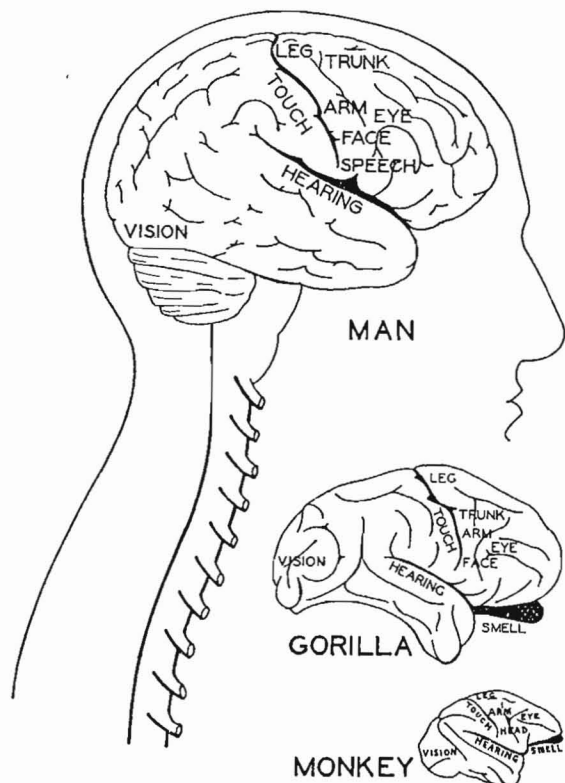
principle, but difficult in practice. To follow a nerve thread from a brain center to the muscle it controls is some job, but just tickle the brain center and the muscle jerks, spotting the connection at once. The brain surface is just uniformly gray, with nothing to label one part as sight center, a second as touch center, and others for hearing, smell, taste or for control over the various body muscles. But a rap on the back of the head makes you see stars or go blind, the sight centers being located there. Or an inside blood vessel bursts over your ear and your arm is paralyzed or your speech gets all mixed up, the centers for the arm muscles and for speech being located close together there.

Strangely enough, the left half of the front brain is connected with the right half of the body, and vice versa. Then right arm paralysis means left brain injury. Most of us, being right-handed, have certain brain convulsions larger on the left, marking the greater skill of our right hands. In left-handed people, this condition is reversed and our early human ancestor (the Java ape-man) is known to have been left-handed because his skull shows these right brain-folds bigger.

Our front brain is in halves because our body is in halves, several of its sense organs (eyes, ears, nostrils and touch) and its arms and legs being paired off right and left. Our eyes today work together and blend their images in the brain, but the eyes of our earlier ancestors worked separately, watching on both sides. Even the most primitive eyes could tell the directions of light or shadow by the relative brightness from the two sides, and right now our ears judge the directions of sounds that way.

So our ape and monkey relatives have brains that match ours part by part. They have more smelling center because they need it more. We beat them, however, in having bigger and better areas for our deep thinking, the so-called "association" centers of our "high-brow" frontal lobes. In the last million years or so, since we left their ranks, this expansion of the areas in which we put two and two together is our really big achievement. For these association centers, with their added nerve connections, give us our comparisons, judgments and general human wisdom, and enable us to see deeper into the future, six jumps ahead instead of just one.

The next article "That Gray Matter We Brag About."



Dragons of the Air

By FREDERIC A. LUCAS

WHEN the Mosasaurs were the rulers of the seas, the Pterodactyls or flying reptiles had for ages held the empire of the air. For in the Jurassic, when birds in the shape of *Archeopteryx* were just beginning to flutter, pterodactyls had long since solved the problem of flight and were present, big and little, in swarms. They must have been particularly abundant about the Solenhofen Sea of Central Europe whose soft, muddy bottom, long ago hardened to rock, furnishes the best lithographic stone, for in this stone beautifully preserved by nature's lithography, many species occur.

Just as Pterodactyls played the part of birds as regards flight, so they seem like the birds to have been creatures of varying size and diverse habits. Some were big as an albatross and sailed majestically over the sea, while others, no bigger than a sparrow, flew merrily over the land in pursuit of insects. There were pterodactyls with long tails, pterodactyls with short tails and pterodactyls with no tails at all. While some flew by day, others, to judge from the size of their eyes, anticipated the owls and flew by night. As to their covering, the evidence and balance of opinion is that unlike most reptiles, they were scaleless. The appearance of some specimens suggested that the wings were covered with small scales or undeveloped feathers, but examination showed them to be only fine wrinkles.*

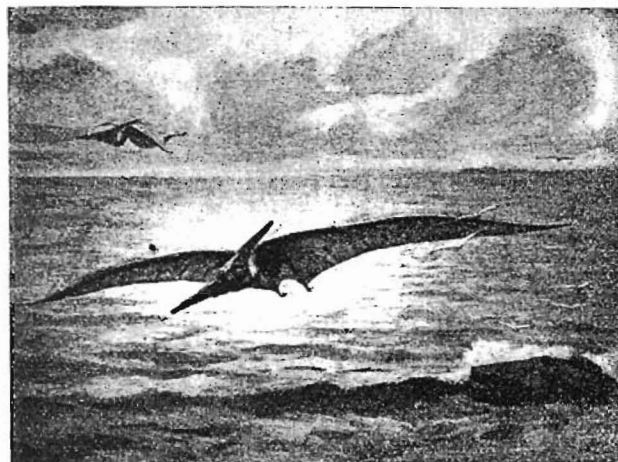
For reasons unknown they were either sparsely represented in North America during the Jurassic period or their favorite cemetery has not come to light: at any rate scarcely any examples have been found and those in fragmentary condition. But later on, in the Cretaceous, pterodactyls became abundant and in what is now the state of Kansas reached their greatest size in *Pteranodon*.

In pterodactyls the wing was formed by a membrane stretched between the little finger and the side of the body. But in *Pteranodon* this "little" finger was nine feet long, the wings having a spread of from fifteen to twenty feet, the maximum reached by any flying animal. The condor and albatross are today the largest flying creatures and they have a spread of wings of from nine to twelve feet, but even this is far under that of *Pteranodon*.

Structurally, *Pteranodon* was a marvel of lightness, the great wing bones being scarcely thicker than a sheet of blotting paper, the body little more than an appendage on the wings. For *Pteranodon* probably did not weigh more than twenty-five pounds, possibly not even that much. Professor Langley was much interested in *Pteranodon* because not only was it the greatest flying creature but because, as indicated by the limited area for the attachment of wing muscles, its flight was performed with very small expenditure of power. Thus while his model aeroplane, the first that actually

flew, required one and a half horse-power for its thirty pounds weight, *Pteranodon*, it is estimated, used but thirty-six thousandths of a horse-power for the same.

One feature of *pteranodon*, the extraordinary crest shown in the picture, has been the cause of much argument; for a time it was even a moot question whether or not it had one. Professor Marsh said he did,



Pteranodon, the Giant Flying Reptile

Professor Williston as vigorously said he didn't, and both were right; some had huge crests, some had none, and why they did or didn't no one really knows. To add to the many theories, it is here suggested that the presence or absence of a crest was a sexual distinction, or that it may have served as a counterpoise to the long beak: finally, that it does not seem at all necessary that it should have served any useful purpose whatever, perhaps being a danger signal that the day of the pterodactyl was drawing to a close.

Among the interesting problems concerning the pterodactyl is how he carried himself on land, and having come to earth—or sea—how he got under way again, and what did he do with those enormous wings. For his joints indicate that those wings could not be folded snugly about the body like those of a bat or bird: from their very size some other method was necessary and it would seem that many of these flying dragons walked with wings pointed upward. But there is no more reason to suppose that all pterodactyls, big and little, behaved alike any more than all birds fly, swim or run alike.

Lastly, to repeat an oft propounded query, do pteranodon and the big birds of today mark the limit of size that may be attained by flying creatures, do nature's flying machines stop at a weight of twenty-five to forty pounds? It would seem so.

The American Museum of Natural History and Yale University each have a fine, mounted skeleton of pteranodon, the latter having one of the few pterodactyl specimens showing the imprint of the wing membrane. The finest European collection is in Munich.

*(Note:—Prof. Broili of Munich has just described a specimen covered with fine hair, or at least, hair-like structures.)

The Earliest Men

By EDWARD GRIEG CLEMMER

IN 1891, Dr. Dubois, a Dutch army surgeon stationed in Java, was hunting for fossil remains of prehistoric animals along the Bengawan River. On a sandy shelf he found a tooth not entirely human, yet not wholly ape-like. Some weeks later he found a skull-cap at the same level but more than a yard away. Next year a thigh bone and another tooth came to light, the thigh bone some fifty feet nearer the river. These four specimens were all at the same level and nearly in line. In 1907 and 1908, Madame Selenka made an expedition to the island, searched very carefully, but found only one more tooth.

From these five remnants: a skull-cap, a thigh bone and three teeth, scientists have reconstructed a creature about half way between the ape and man. It may seem absurd to reconstruct an entire man from such fragments, but the methods warrant the conclusions reached by the experts. The skull-cap tells a great deal about the enclosed brain and indicates the creature's intelligence. The teeth tell something of the character of the jaw and of the food the possessor ate. The smooth end surfaces of the thigh bone in contact with the hip socket and shin bone help to decide the angles at which the bones were placed and therefore whether the creature stood erect, as does man, or slouched, as does the ape.

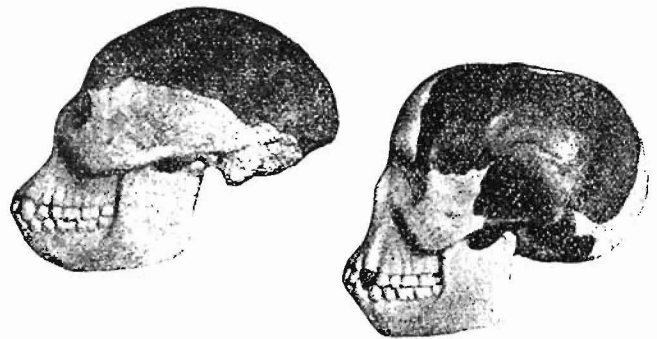
The skull-cap has a very marked ridge over the eyes, a sloping, narrow forehead and a brain capacity estimated at about 985 cubic centimeters. The capacity of an adult male gorilla is 550 cubic centimeters and the African bushman, a very low type of present man, 1240 cubic centimeters. The thigh bone indicates that the Java man walked erect and freely used his hands. In view of the primitive skull and the erect posture, the creature was given the scientific name "Pithecanthropus erectus," the erect ape-man.

After the ape-man period comes a great gap of hundreds of thousands of years while the earth was in the icy grip of the first and second glacial ages. Then the ice withdrew and warm weather returned, with an abundance of plants and animals. The time was again ideal for mankind. From this period we have recovered one human jaw, buried 82 feet below the sur-

face in a sand pit six miles southeast of Heidelberg, Germany, whence its name, the Heidelberg jaw.

Perhaps its most striking characteristic is the lack of chin. Were not the teeth conclusively human, it could well have been taken for the jaw of an ape.

The next important find is the Piltdown skull. The English anthropologist, Charles Dawson, walking down a Sussex road, noticed that some fresh earth contained brown flints not common in that part of the country. He traced them to a gravel bed and warned the work-



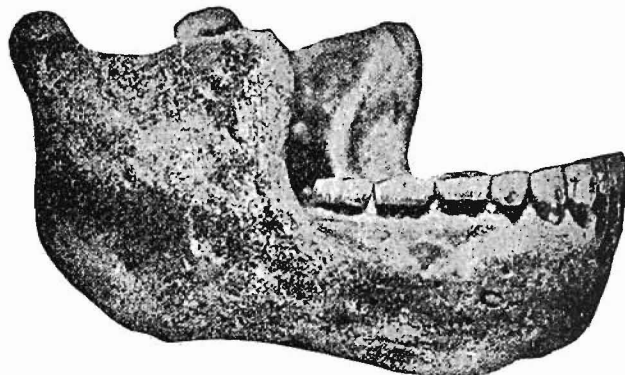
*Restored Skulls of Java Ape-man and Piltdown Dawn-man
(Dark parts found; light parts restored)*

men not to throw away any bones they might find. When later, a workman showed him a broken human skull bone, he searched carefully, but found no others. But in 1911 he found part of the forehead and the ridge over the right eye. Then, in the spring of 1912, with Dr. A. Smith Woodward of the British Museum, he made a systematic search, even sifting the loose earth for small fragments. They were rewarded with more skull parts and the broken right lower jaw.

The skull, when pieced together, was very peculiar and excited much controversy. All agreed that the skull was humanly modern, but differed as to the jaw. For the jaw was very primitive and the experts could not understand why it had not developed in proportion to the skull. Some thought it the jaw of a chimpanzee and even gave this new species of ape a name. Every scientist qualified to judge considered and debated the evidence. After a virtual "ordeal of fire," in which every scrap of evidence, both pro and con, had been carefully weighed by the most competent men in the world, remains of a second individual came to light, indicating that the fragments were of one individual.

The cranial capacity of the skull was set by Woodward at 1070 cubic centimeters. The brain case was thick, but the forehead much higher than that of the Java man, even higher than that of the Neanderthal race which came much later. However, from a study of the cast of the brain cavity, G. Elliot Smith, a high authority, concludes that the brain center in control of articulate speech was but feebly developed. He was "Eoanthropus," a true "dawn man." His skull marks him as ancestor of man, but his jaw shows that he was not yet full fledged.

We have seen that the Java man stood on the border line between the ape and man, that the Heidelberg



Fossil Jaw of Heidelberg Man

man developed further, but was still very much an animal, while the Piltdown man stood at the very dawn of the human day. The stage is set for the appearance of true man, well started on his long, upward journey

to the exalted state we occupy as "Homo sapiens," the Wise Men.

This is the second of four articles by Mr. Clemmer on The Ancestors of Modern Man, the next being on The Neanderthal Race.

Mammals That Lay Eggs

By MAYNARD SHIPLEY

EGG-LAYING is usually thought of only in connection with birds and reptiles. But at the antipodes we meet with queer creatures which possess some characteristics of both reptiles and mammals. When specimens of these paradoxical animals were first taken to England, they were forthwith pronounced a fake, on a par with the composite "mermaids" exhibited in those days.

Exploring in southern Australia, one might come across a strange creature known locally as the "duck-bill mole"—a specimen of one of the two distinct families of these curious egg-laying mammals—an animal about a foot and a half long, with a broad, shovel-like snout, strongly resembling a duck's bill. The feet are webbed, but differ from the duck's in having five toes, armed with sharp claws. But the body is well covered with soft dark-brown fur. Frequently the creature may be seen in a sitting posture, supported partly by its large, flat tail.

The duck-bill is a timid beast, and must be approached very cautiously. Watching its movements, one may see it fill its cheek-pockets with food—chiefly water-snails and bivalves—and then dive into a pond. But it does not come to the surface again, even to take air, though one wait patiently an hour or more for its reappearance. Yet no lung-breathing fresh-water creature can "hold its breath" for so long. Where can the queer mammal be?

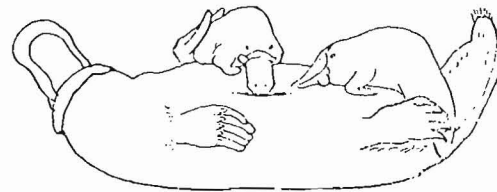
At last the secret is out! Mrs. Duck-bill (*Ornithorhynchus*) has gone to her burrow to lay an egg. Fancy a mammal with soft brown fur going home to lay an egg! But surely she does not lay her eggs under water! She does not. But the entrance to her "one-room apartment" is below the water-line, safe from all intruders. Entering her water-hidden burrow, Mrs. Duck-bill passes through a tunnel which slopes gently upward for a distance of 25 to 50 feet, where there is a rather large chamber with top ventilation, lined with reeds and rushes. Here in a comfortable nest of soft grasses she lays her two or three eggs, less than an inch long, with flexible, parchment-like shells—of reptilian, rather than bird-like, character.

The eggs are incubated, as in the case of birds, by the body-heat of the mother—such as it is. For curiously and suggestively enough from the standpoint of evolution, the body temperature of the *Monotremata* (to include all the species of this order of mammals) is intermediate between the cold-blooded reptiles and the "regular" warm-blooded mammals; and, as in the case of reptiles, the body temperature changes to the extent of some 25 degrees Celsius with the rise and fall of the atmospheric temperature. This is in agreement

with the theory of many zoologists that the *Monotremata* of today are the somewhat modified descendants of the transition type of animals leading from mammal-like reptiles to reptile-like mammals, thence to a generalized type of the monotremes, on to the pouched animals (Marsupials), and through the latter to the true (Placental) mammals.

After this glance backwards, to a period some two hundred odd millions of years ago, when egg-laying mammals first came into being, let us return to the burrow of Mrs. Duck-bill of today.

Having hatched her family of two or three lusty



Mrs. Duck-bill Serves Dinner

duck-bills, from her reptile-like eggs, what next? Will these youngsters follow the example of all other orders of egg-laying animals and begin to "pick up" a living for themselves, like a new-born chick or an infant reptile?

The little ones are born with a perfectly good set of teeth, whereas mother duck-bill's dental equipment has disappeared, giving place to broad, horny plates, which line the inside of the "bill." And here is where evolution comes in again—for the original *Monotremata*, whose fossil remains are found in the Triassic rocks, are provided with teeth, even in the adult stage, similar to the teeth of an infant duck-bill today. This is in accord with Haeckel's "biogenetic law."

Anyhow, though hatched from an egg like a reptile, the queer little duck-bills are mammals, after all; and the infant mammal feeds on mother's milk. And these strangest and most paradoxical of all mammals form no exception to the rule. For though mother duck-bill has no true mammary glands—representing as she does a stage in evolution prior to the appearance of true mammals—she is nevertheless provided with modified oil glands which in primitive fashion perform the same useful function. These glands, buried deep in the abdominal hair, secrete real milk, through a sieve-like aperture. Eventually, the "milk-teeth" of the growing youngsters are worn off, and are replaced by plates, "just like Mamma's."

There is another family of these strange egg-laying mammals, the Echidnas, both in Australia and New Guinea, covered with quill-spines instead of fur. But that is another story.

EVOLUTION

A Journal of Nature

To combat bigotry and superstition and develop the open mind by popularizing natural science

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IN DEFENSE OF HONESTY.

Your fundamentalists claim all the virtues and charge the scientists with the most malevolent intentions. But I know many scientists and I find them kindly of intention and most honest in attitude. None that I know have dire designs on youth or morals.

But I have recently read some books of "fundamentalist science" and now wonder at the nerve of these who proclaim their own virtues. For it is not ordinary honesty to distort meanings and argue jesuitically, even for the glory of your god, and these things they do. It is easy to quote from diffident and honest Charles Darwin when he considers the whole case, the doubts alongside the proofs. It is easy to ignore the overwhelming proofs and to magnify the doubts most plausibly. You can cleverly alter his plain meanings and so force unmeant confessions from him. But you cannot so win any respect for your honesty.

I prefer the scientific attitude, the attitude that seeks earnestly, without thought of consequences, that makes no pretence to knowing all, and modestly talks not at all of its virtues, yet scorns those who withhold or tamper with actual evidence or who permit bias or preference to color their utterance. For honesty, give me your scientist; for craven subservience to prejudice, your fundamentalist.

A. S. B.

EXPIRED?

If YOU started with No. 1 of EVOLUTION, your subscription has now expired, unless you renewed. Better renew right away, lest you forget. And still better, send the subscriptions of at least four friends along with your renewal. Remember that in lists of five or more we accept yearly subscriptions at fifty cents each.

RILEY SEEMS A LITTLE RILED.

The fact that the New York audience voted against him almost unanimously after his recent debate with Professor Joseph McCabe seems to have riled our Reverend Doctor Riley somewhat, judging from the tone of his remark regarding the audience (which we reprint under "Funnymentials" where it belongs) and the amount of space he again devotes to the subject in the April number of his magazine.

He consoles himself with the vote of the judges, but does not mention the fact that of the sixteen judges placed on the list by EVOLUTION only twelve were present, all of whom seem to have voted for Professor McCabe, and that instead of limiting his own list of judges to an equal number, as agreed, seventeen of his fundamentalist friends were seated because the EVOLUTION committee-man did not happen to be present at the moment. Naturally his seventeen friends voted for Riley, and he is welcome to whatever consolation this means to him.

We are printing the stenographic record of the debate in full in EVOLUTION, so that our readers can judge both arguments for themselves. We offered to let Dr. Riley have the record for simply his share of the expense of transcribing it. He refused. We now challenge him to print the entire stenographic record of this debate in his magazine, so that his readers also can judge the arguments, instead of merely his biased reports of the matter. Let the Reverend Doctor "put up or shut up."

WOMAN REARED BY APES

The newspapers carry the following story:

"An explorer invaded a colony of apes in the wilds of Africa. The apes promptly took to the trees and disappeared, leaving behind one apparently less nimble than the rest. This proved not to be an ape at all, but a negro woman, whose body, unlike those of the rest of the negro population, was free from tattoo marks. The explorer learned that she had been stolen by the apes in infancy and brought up among them."

If the story proves true and this woman learns to speak and so communicate her experiences, we should get a most interesting picture of the intimate life of these jungle folk.

HAIL STREET SPEAKERS.

On these balmy spring evenings every street speaker worthy of the name feels the urge within him to make the welkin ring with his message. EVOLUTION sells like hot cakes at street meetings. I'll stake you to a bundle of twenty so you can try it out. Let me hear from you instant. L. E. K., care EVOLUTION.

N. Y. EVOLUTION DINNER FRIDAY, APRIL 26th.

The Evolution Anniversary Dinner in New York has been postponed to Friday, April 26th, and will take place in the beautiful Pythian Temple, 135 West 70th Street, beginning at seven o'clock.

Miss Grace Potter will be Toastmistress. Among the speakers will be Chard Powers Smith, George Clyde Fisher, Abraham Stone, Allan Strong Broms, Frank A. Sieverman, Moses Oppenheimer and Arthur Garfield Hays.

At this Dinner plans will be announced for a tremendous campaign for the second year of EVOLUTION. Every reader who can be in New York, April 26th, should of course attend this important celebration and bring some friends. Many out of town readers are expected to send suitable "birthday greetings" to be presented at this New York Dinner to EVOLUTION.

The rate is three dollars, including the Dinner. Tickets for the speaking only may be had at one dollar. Reservation should be made at once at the office of EVOLUTION.

BROMS LECTURES.

The course of five illustrated lectures on "EVOLUTION: FROM STARDUST TO BRAIN-STUFF" that Mr. Allan Strong Broms, science editor of EVOLUTION, has just given in New York proved such a great success from an educational as well as financial standpoint that arrangements will be made to give similar lectures weekly throughout the season, beginning in September.

The subjects of the lectures already given were: 1. Worlds in the Making; 2. The Earth's Coming of Age; 3. Animals of the Past; 4. The Pedigree of Man; 5. Brains—How Come? A special lecture is announced for Friday evening, April 12th, on "The Royal Road to Learning," at Union Auditorium, 229 W. 48th Street, New York City.

Organizations in Eastern cities that would like to avail themselves of Mr. Broms services as science lecturer next winter should make immediate application.

AN OPTIMIST

"Evolution," quoth the monkey,
"Makes of all mankind our kin.
There's no doubt at all about it,
Heads—they lose, and tails—we win."
(Author not known.)

LET'S SEND YOU A BUNDLE.

The McCabe-Riley Debate, starting in this issue, will be completed in three numbers of EVOLUTION. For a dollar bill we'll send you five copies of each issue containing the debate as it appears. Let us send you a bundle and get your friends to reading. That's the best way to convince the doubting Thomases.

OVER FIVE THOUSAND SUBSCRIBERS.

With the twelfth issue EVOLUTION achieved over five thousand individual paid subscribers. This gives cause for congratulation to every friend of EVOLUTION, who during this year has helped to build up this list by sending new subscribers. It augurs well for the future of EVOLUTION. Doubling the list once more will give the necessary circulation to make EVOLUTION a self-sustaining enterprise.

Here's how it looks by States:

Alabama	20	New York State	494
Alaska	2	New York City	675
Arizona	26	North Carolina	29
Arkansas	56	North Dakota	46
California	551	Ohio	299
Colorado	83	Oklahoma	32
Connecticut	32	Oregon	90
Delaware	12	Panama	1
D. C.	43	Pennsylvania	159
Florida	34	Philippines	2
Georgia	16	Rhode Island	9
Hawai	11	Porto Rico	2
Idaho	8	South Carolina	20
Illinois	486	South Dakota	58
Indiana	50	Tennessee	27
Iowa	22	Texas	67
Kansas	85	Utah	55
Kentucky	22	Vermont	2
Louisiana	6	Virginia	24
Maine	12	Washington	182
Maryland	58	West Virginia	10
Massachusetts	147	Wisconsin	66
Michigan	256	Wyoming	9
Minnesota	145	Canada	141
Mississippi	4	Other countries	150
Missouri	120		
Montana	34	Total	5184
Nebraska	42		
Nevada	1	Bundles sold on	
New Hampshire	9	consignment	2538
New Jersey	141		
New Mexico	11	Grand total	7712

This circulation is being achieved by the volunteer efforts of our readers. Those who have sent five or more subscribers since our last report two months ago are listed in this

HONOR ROLL

16 S. Lauderdale	6 O. J. Schuster
15 A. W. Bell	6 Frank Doster
13 Ruth Orange	6 Irving Miller
13 B. Sandman	6 C. J. Goetz
12 Claude Scott	6 W. J. Lockhart
11 I. D. Cardiff	6 M. A. Stolar
11 George Koop	6 Hy. Scharlock
10 L. A. Drew	6 Wm. Myerson
9 G. Elfernack	6 V. Coleman
9 I. W. Howerth	6 Ches. Swingard
8 J. DeRose	6 F. J. McNey
7 Fred N. Weiss	6 Emil Falk
7 Geo. K. Spahr	6 Fred Blossom
7 W. R. Green	6 J. C. Keegan
7 A. I. Urquhart	6 V. M. Tanner
6 C. R. Peterson	6 F. Wheeler
	6 Smith Bk. Co.
	6 A. Chernay

Five from each of the following: R. B. Wilson, Thos. L. Brunk, F. H. Harris, E. L. Prizer, A. M. Gilbert, Alfred Langer, Henry Caldwell, M. A. Hanna, E. G. Clemmer, Alvin Haug, W. F. Copeland, Frank Hart, Floyd Ramp, H. S. Warren, Ray S. Knorr, W. H. Draper, Chas. F. Clagg, F. W. Adsit, G. H. Miller, John Swanson, M. T.

Skjolaas, A. H. Candee, Fred Burger, F. Hall Childs, Erma Lee, Richard White, Carl M. Decker.

What these have done, YOU can do. Show this issue to some of your friends. Let us have at least a list of five as birthday greetings, and make next Honor Roll.

OVER THE TOP.

The Five Thousand Dollar Promotion Fund has gone over the top, thanks to the splendid co-operation of the following friends, each of whom has contributed the specified amount since last report:

S. Lauderdale, \$2.00; Charles R. Peterson, \$1.00; J. E. Vojan, \$5.00; Albert I. Elkus, \$1.00; R. H. Jenkins, \$5.00; W. J. Lockhart, \$5.00; Junius Henderson, \$2.00; George E. Coleman, \$20.00; John Brezovsky, \$5.00; John B. Henck, \$1.00; Chas. P. Sigerfoos, \$1.00; L. E. Trainor, \$1.00; Tobias Sigel, \$10.00; Caspar W. Hodgson, \$5.00; Allan Strong Broms, \$10.00; Wm. H. Seamen, \$1.00; Robert E. Lee, \$50.00; L. T. B. Light, \$300.00; M. M. Cox, \$11.00; J. W. Beede, \$1.00; A. L. Herrera, \$1.00; Mr. and Mrs. A. E. Comes, \$2.00; Martin Dewey, \$300.00; A. Berthelot, \$2.00; John Dewey, \$3.00; Josep Llord, \$2.00; Mrs. Ellen R. Nagle, \$5.00; M. Mark, \$60.00; Wm. H. Whittekin, \$35.00; Evangeline W. Young, \$2.00; Cecelia Silk, \$3.00; Charles Fuchs, \$5.00; F. R. Burnham, \$3.00; R. Abrahams, \$10.00; Joseph Kovar, \$10.00; Chas. W. Rappold, \$10.00; Frances Pilat, \$50.00; Caro L. Strobell, \$3.00; Michael A. Cohn, \$10.00; Arthur Garfield Hays, \$10.00; Chas. A. Severance, \$1.00; F. A. Sieverman, \$10.00; Leo Turbow, \$12.00; Emil Falk, \$3.35; A. A. Brill, \$10.00; N. W. Lerrmon, \$1.00; Mignon Talbot, \$14.00; W. B. Palmer, \$.50; Henry L. Gonor, \$1.00; Wm. Floyd, \$25.00; Watts and Co, \$1.40; Total, \$1,042.25.

Previously reported paid, \$2,210.00; Pledges, \$1,800; Grand Total, \$5,052.25.

A journal whose friends give such evidence of their support during the first year of its existence can look toward the future with confidence. Our Promotion campaigns for EVOLUTION will be made in proportion to the funds provided by readers. For every dollar contributed at least twenty copies of EVOLUTION will go out into the world. We hope that there will be such a response on the occasion of our anniversary this month, that the field of usefulness for the coming year will be multiplied manifold.

WHY NOT JOIN US?

Wouldn't you like to join us in this enterprise of enlightenment? Our immediate business is publishing this journal, EVOLUTION, and selling books. Later we shall develop a Lyceum Bureau for touring natural science lecturers.

Additional capital is needed to push circulation campaign for EVOLUTION. For this purpose Evolution Publishing

Corporation offers its \$10 shares of preferred stock, and gives one \$10 share of common, voting stock with every block of five shares subscribed this month.

It is expected to make the business pay, but shareholders are not invited with the promise that they will "get rich," but because of their interest in furthering this educational work.

Checks should be made payable to EVOLUTION PUBLISHING CORPORATION, and you should specify whether payment is in full, or whether it should apply on a larger block of stock to be held until balance is paid.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., required by the Act of Congress of August 24, 1929, of "Evolution," published monthly at New York, N. Y., for April, 1929.

State of New York,
County of New York
ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared L. E. Katterfeld, who, having been duly sworn according to law, deposes and says that he is the Managing Editor of the "Evolution," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

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L. E. KATTERFELD, Mgr.

Sworn to and subscribed before me this 3rd day of April, 1929.

JOSEPH R. BRODSKY.

(My commission expires March 30, 1930.)

Our Face from Fish to Man

Our readers will be glad to hear of the publication of Dr. Wm. K. Gregory's new book, "Our Face From Fish to Man." In Addition to a review by Dr. Horace E. Wood, Jr., of New York University, we reprint below Dr. Gregory's own preface and the foreword by Wm. Beebe.

"OUR FACE FROM FISH TO MAN," by William K. Gregory. 295 pages, 118 figures. G. P. Putnam's Sons, New York. \$4.50.

It seems hardly necessary, nowadays, to identify Dr. William King Gregory as Professor of Vertebrate Paleontology at Columbia University, and Curator of Comparative Anatomy, Curator of Ichthyology, and Associate in Vertebrate Paleontology and in Physical Anthropology at the American Museum of Natural History. It is a logical assumption that Dr. Gregory would be the universal choice as the individual best qualified by training and ability to write such a book—and the result certainly accords with such a prediction.

The subtitle, "A Portrait Gallery of Our Ancient Ancestors and Kinsfolk, Together with a Concise History of Our Best Features," gives only a hint of the treat in store for the reader, whether technically trained or not. The wealth of magnificent illustrations (in large part drawn from Dr. Gregory's own work) almost tell the story in themselves. They are reinforced by a text that is always accurate, always readable, and sometimes distinctly sprightly. It would be no reproach to so excellent a book to be simply a compilation of other men's results; but a surprising portion of the book rests on the original work of Dr. Gregory himself, and he has focussed a large part of the remaining material into a new synthesis. Mr. William Beebe contributes a characteristic foreword.

Although the title specifically disclaims such broad inclusiveness, this book comes closer to being an adequate modern treatment of vertebrate evolution than any other book on the market.

Science moves forward, most of the time, by detailed studies of minute points. Finally, the layman, the student, and even the specialist, find themselves oppressed by the dead weight of a mass of unassimilated detail. Then some analytical mind brings order out of chaos, and everyone says, "Why, of course, it couldn't be any other way." For such a synthesis, we are now indebted to Dr. Gregory.

"Wholly ignorant of the facts, the ancient Jewish priests indulged themselves in the fancy that man was made in the image of God; but modern science shows that the god-like

mask which is the human face is made out of the same elements as in the gorilla; and that in both ape and man the bony framework of the face is composed of strictly homologous elements, inherited from a long line of lower vertebrates." (P. 91.)

—Horace Elmer Wood, 2nd.



WILLIAM KING GREGORY

PREFACE

According to popular standards of civilized peoples, men of one's own race and tongue were called "men," "warriors," "heroes," but people of other races were "barbarians," "unholy ones," "foreign devils." The founder of one's own clan was often considered to be the son of a deity, while the barbarians were the descendants of monkeys or other wild animals. Or the first man was created perfect, in the image of God. One's own family, of course, was fairly true to type but sin had played havoc with the features of other races. To believe all this was comforting to one's own "face" in a world where the inferiority complex occasionally haunted even kings.

Imagine then the effect of telling one-hundred per cent Americans that they are not the descendants of the god-like Adam but are sons and daughters of *Dryopithecus*, or of some nearly allied genus of anthropoid apes that lived in the Miocene age—and that before that they had long tails and ate grubs and beetles!

If the reader is curious to know the worst he will find it in these pages.

There even his own great-grandfather—a Jove-like patriarch with ample beard, piercing eyes and an aquiline nose—will be subjected to unsparing analysis. It will be shown how much the proud old gentleman was indebted to a long line of freebooting forebears that struggled for a precarious living in the sea, on muddy flats, on the uplands or in the trees—aeons before Adam delved or Eve span. In detail it will even be charged that the real founder of the family was not the powerful settler to whom the king gave a grant of land extending far back from the river, but a poor mud-sucking protochordate of pre-Silurian times; that when in some far-off dismal swamp a putrid prize was snatched by scaly forms, their facial masks already bore our eyes and nose and mouth.

Accordingly, this little book can hardly expect much popularity either in Tennessee, where the very idea of evolution is anathema, or in the metropolitan strongholds where pitheco-phobia is still prevalent and man's complete superiority to the all too man-like apes is somewhat nervously stressed.

Nor can the author hope for much favor from the public, that wants only results and is willing to spend a billion dollars annually on cosmetics and safety razors. For this book does not pretend to tell how to improve one's face but only how and why one has one.

At best then it can only hold a magic mirror up to proud man and bid him contemplate his own image—a composite of an infinitely receding series of faces—human, prehuman, anthropoid, long-snouted, lizard-like—stretching back into the shadows of endless time.

W. K. G.

FOREWORD

By WILLIAM BEEBE

A foreword to a volume such as the present one of Dr. Gregory's is as superfluous as would be the retention of the third eye, the Cyclopean one, of our ancestors, in the center of our forehead today. No more wonderful subject for a volume could be imagined than the evolution of the human face, and no more competent author than William K. Gregory. The result seems to me eminently satisfactory.

If the reader's interest is real but cursory, let him do nothing but look at the illustrations. They will ensure a thousand per cent interest to every walk along Fifth Avenue or Regent Street. If pressure of other interests permits only an hour's perusal, or complete lack of natural history knowledge requires facts to be strained through the mesh of popular language, read but the preface and the first few paragraphs of each chapter. Taken as a whole this is not a "popular" book in the sense of a superficial one. The details of evolution of our eyes, ears,

The Amateur Scientist

A MONTHLY FEATURE conducted by ALLAN STRONG BROMS

Spring Flowers

"The flowers that bloom in the spring,
tra la,
Breathe promise of merry sunshine."

BUT not for themselves. For soon the trees above will be putting out dense thickets of leaves to cast deep shadows below. Light means life in

the plant world and shadow death. So many of the smaller plants have solved the problem by beating their tree neighbors to it in the spring, shoving their leaves up quickly before the tree shadows thicken.

They live briefly, but completely. By braving the spring chill, they manage to show their flowers, get them fertilized and so accomplish the important work of getting the next generation well started on its way, all before the slower trees have put out their foliage for the summer. This duty to the future done, they shrivel away into inconspicuousness. They are in such a rush about it all that one hardly realizes spring has come before they appear and quickly pass away.

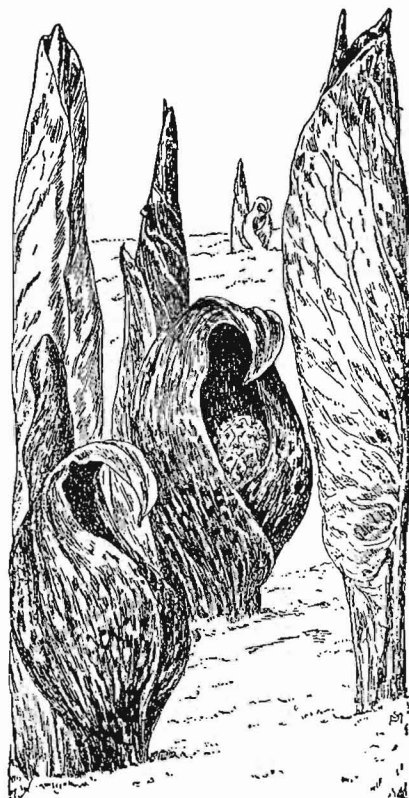
Thus the spring flowers, besides promising summer days and providing poets with sweet subjects, exemplify such celebrated virtues as seizing time by the forelock, doing today what would be too late on the morrow and practicing the rule of early to bed and early to rise. This virtuous tribe is quite numerous, but just look for these: Skunk cabbage, False Hellebore, Adder's tongue, Trillium, Rue anemone, Bloodroot and Jack-in-the-pulpit, all well matured before the ordinary plants have started in.

First of all, usually, is the Skunk cabbage. Being such an early plant, it wraps itself cozily to keep warm. Besides, it makes friends with certain little flies that venture forth while the air is still chilly by providing them with warm shelter within its wrapper of leaves. In return, these flies bear the plant's pollen from flower to flower and so effect the fertilization

which starts the seeds growing. You wonder where the flower is, for there are no colored petals. The working parts are there all right, colors being but a lure, replaced in this case by a strong odor, attractive to the flies, but disagreeable to us, whence the very descriptive name "skunk cabbage."

Jack-in-the-pulpit lures the pollen-bearing insects with color and sweet nectar in its flower. But it wants only those that fly, for crawling insects make slow progress between plants and knock about so much on the way that they lose and waste the precious pollen. So Jack, despite his pious pretensions, traps and kills the creeping wastrels, while letting the flying kinds come and go. The inner walls of his pulpit are slippery and impossible to climb. Only the flying insects make their way out and this is quite as the plant would have it.

To effect the quick spring growth, the Bloodroot and many another spring flower lays in a food reserve in rootstock, bulb or tuber.



Skunk Cabbage.

Symplocarpus foetidus



THE BLOODROOT AND ITS FOOD-STORE

nostrils, mouth—these are too delicate, too intricate for words of one syllable. Yet to read and understand this volume requires no more concentrated attention than the remembrance of the highest diamond in the ninth trick, or to what Steel Preferred fell in the Autumn of 1914.

I advise no Fundamentalists or Anti-Evolutionists to read it, for if he have no sense of humor he will not understand it, and if he have, his belief will be like Dunsany's King who "was as though he never had been." If with Bergson we believe that the origin of laughter was cruelty, then an S. P. C. to something should be formed to prevent the spectacle of a Fundamentalist's face functioning with the third eyelid of a bird, the earpoint of a deer, the honorable scars of most ancient gills, and with his lip-lifting muscles in full action as he sneers at truth. A moment's thought of these few characters presents a new viewpoint on what we are wont to call the "lower"

animals, for if our third eyelid were more than a degenerate flap we, like an eagle, could look straight at the sun; if our ears could straighten and turn as once, the lives of pedestrians would be safer; if the ghosts of gills were still functional, drowning would be impossible, and if the fang-revealing sneer showed less degenerate canines, we might have a more physically wholesome fear of cavaliers against the doctrine of Evolution.

The impregnable array of facts gleaned through the centuries of man's intellectual supremacy proves beyond all question the gradual rise toward human perfection of the various components of the face, and this confirms our precious organs of sense as most noble gateways of the human mind and soul. Kindness, gentleness, tactfulness, patience, can flow out through only these channels. It is a worthy thing to have written a book about them; it is a fortunate chance to be able to read it.

A kindred group of flowers is exemplified by the Crocus of our spring fields. Its problem is not that of avoiding summer shadows, but of escaping the choking summer growth of grass and weeds. So it too comes out early, lives its brief life and quickly goes back to rest through the seasons of summer crowding and winter freezing. Out in the open, exposed to cold winds and late frosts, it has developed a warm coat of fuzzy hair, enabling it to brave the spring chills a bit earlier than its plant rivals.

So even the flowers are engaged in a bitter struggle for existence in which chance variations of structure or habit which favor survival are preserved by natural selection, thus causing evolution towards forms and ways better fitted to meet the problems of their environment.

McCabe-Riley Debate*(Continued from Page 2)*

I could run over the whole of the earth and point out that wherever you find an island population, if that island is a detached fragment of the main land, the animal population came from that main land. In every part of the earth animals and plants are distributed without one single exception precisely as the law of evolution demands. I want an alternative explanation not only of the distribution, but most particularly of the exact coincidence of that distribution with the theory of evolution.

Then I turn to the animals themselves. Why has the python the rudiments of legs and claws in its body? Why has the bird the rudiments of toes on the corner of its wings? Why has the whale vestigial limbs and leg bones in the flesh?

I could wander over the whole animal world. If those animals evolved, we understand it, for organs which are thrown out of employment gradually decay. Over and over again, we find that those organs were useful in an earlier generation. We find hundreds of such evidences in the animal world. I want an alternative explanation for that.

We turn to man. Why, there are in the body of man alone fifty or sixty useless organs or parts of organs which cannot be explained by any theory except evolution. These bits of gristle on the side of your head, your ears, will refute all the anti-evolutionists in the world. No one can tell us that medical men cannot say whether these are useful or not. They are useless. With these fifty or sixty useless organs in the human body today we do not need to find one single bone or one single stone of early man. We need only one living human body, and I defy all the anti-evolutionists of America to interpret that body on any lines except those accepted by evolution.

Thus two lines of evidence coincide. And if the story of evolution is true, somewhere in the rocks underneath your feet you will find the bones of the ancestors of the animals and plants of today. We open up the rocks of the earth just here and there, just in little tiny scratches, as it were, but we have dug out literally millions of remains of animals and plants of long ago.

I ask Dr. Riley to tell me of one of those remains that is inconsistent with the doctrine of evolution.

I say that we have rarely opened up the rocks. But there is one seam of rock which we are vigorously exploiting all the world over. I mean our coal seams. Will Dr. Riley tell us why we have never found in any coal seam in the world any bone of any mammal, any flowering plant, any bee, any ant, any wasp? The entire life of that great formation is familiar to us. Why has no geologist ever found in it a trace of any animal higher than the amphibian?

Why, beneath the level of the chalk—and you know the greater part of Europe lies level like a billiard table—why, beneath that chalk have we never found the bones of one single animal even remotely resembling the animals of today?

The order of the rocks was determined more than one hundred years ago, long before any geologist in

the world entertained the idea of evolution. Why, when we started the idea of evolution, was it found that the millions of fossils in those rocks corresponded without one single exception to the theory of the evolutionist? Or if there is an exception, let us hear of it tonight.

Those are three lines of evidence, the coincidence of which requires a serious explanation. I assume that it is universally true, without a single exception. It is up to my opponent to give you exceptions. But I am not finished with those three lines.

Many of you have seen a mountainside. You have seen the seams of rock twisted and torn as by some convulsive force. Does anybody imagine that they were created in that condition? Surely, they point back to some long period of time in which the sands were laid down on the floor of the sea and later pressed into that solid condition you find today. Thus the earth itself tells you of evolution, which the geologists have known for years to run into hundreds of millions of years.

Then comes another science just at the last moment. Decade by decade the proofs have accumulated. Some time ago we discovered the wonderful elements thorium and uranium, breaking up and turning into lead. Scientific men said: "We know how long it takes uranium to turn into lead, so let us test the chronology of the earth." Once more this new line of research, the most magnificent trial of physical science—said: "Those rocks run back to something like more than one billion years from the present time." One more triumph for evolution. And nothing has transpired that is in the slightest degree inconsistent with evolution.

Why is our earth in the condition in which it is today? Why is Mars so much colder and so much thinner in atmosphere than the earth? Why is the moon the dead, frozen world that we know it to be today? Why does our earth come between them? Why does the sun remain that mass of boiling vapors that it is today? Every single feature of every single body of our solar system corresponds perfectly with the theory of evolution.

When I look out over the great universe, this massive system of two billion stars that we know today, once more every object in the universe teaches evolution to us. There are the giant red stars, the young stars, the imperfectly condensed masses of matter rising in temperature. There are stars packing closer and closer, getting hotter and hotter. There are blue-white stars tens of thousands of degrees in temperature and then, going down the scale, dying suns down to the dull, blood-red star that once shone white in the sky billions upon billions of years ago.

Not only on the earth, but from end to end of this universe which we sweep with mighty telescopes, there is not one single object inconsistent with the doctrine of evolution. There are myriads of objects, but there is not one single thing in this universe that is inconsistent with the doctrine of evolution. There are two billion human beings. There are two billion stars. There are billions of animals and plants, and all of

them are not merely consistent with, but most eloquent examples of the doctrine of evolution.

Those are the reasons why, for the last twenty-five years, there has not been one man of science who doubted evolution. Seventy years ago Charles Darwin gave out this doctrine to the world. You know the controversy. Ten years later ten per cent of the scientific men of the world were evolutionists. Twenty-five years ago the last scientific man died who questioned evolution. And there is not an expert of the fifteen branches of sciences today who will not tell you that it is one of the most solid principles we have in modern science. Its basis is the universe, and the mark of evolution is stamped upon every particle in that universe.

The second part of my thesis I have deliberately almost ignored, not because my time is up, but because I need not debate it. If evolution is true, it must be taught in all the schools. The whole question is: Is evolution true?

If Dr. Riley tells us that, whether evolution is true or not, he will oppose its teaching, he puts himself in the ambiguous position of saying to the men and women of this nation that truth shall not be taught to the children in the schools.

I believe that I have in a simple outline justified that unanimous verdict of the men of science of the world. That is all you will require of me in the opening speech. Now, I ask for some alternative explanation of that convergence of the four or five massive lines of evidence for the doctrine of evolution. I ask for some general explanation other than that I have put before you. But I am particular that you keep clearly in your mind that intellectual conception of the doctrine of evolution as an interpretation of the nature that lies before you, and I am sure you will find in the end that those men of science are justified who say that never until Darwin appeared was there so illuminating a truth. Never was there such a sudden light thrown upon the problems that have agitated the human mind during the last two thousand years. (Applause.)

THE CHAIRMAN:—On the other side, Dr. Riley will speak for twenty-five minutes.

DR. W. B. RILEY:—Mr. chairman, ladies and gentlemen: I have listened, as I have on former occasions, to my friend and opponent, Professor McCabe, and have been reminded, as I have been on previous occasions, of what President King of Oberlin said: "An educated man can make a fair speech on any subject." And I am willing to consent that my brother has done the best he could with the theme that he had in hand. (Laughter.)

A great many of you have, doubtless, at some time or other, seen, in the streets, little youngsters carrying a balloon. The thing is beautiful as long as it has human breath in it. But the moment you puncture it, it is a sad-looking affair. And that is exactly what I propose to do with this McCabe speech. (Applause.)

I want, therefore, to set aside all irrelevant discussion, and I can do that by agreeing absolutely with

Professor McCabe's last point. If evolution is true, by all means it should be taught in public schools. It should be taught everywhere. (Applause.) The truth should be taught. (Applause.) But if evolution has no truth in it, not a scintilla of science, then it should be suppressed, and not imposed upon immature minds. That is my contention. (Applause.)

This is the sixth debate that the Professor and I have engaged in. Each time he has begun as he did and ended as he did tonight. He has one forceful argument, namely, that "all scientific men are agreed."

It would seem to me after having read the Professor's published books, as I have assiduously done, that he should have learned by this time that no science is established by the counting of noses. Now, as a matter of fact, he does know that, and he has consented to that very proposition.

I want to quote from him tonight: (Reading) "*We do not even 'rely on the testimony of millions' if they have nothing better for their assertion than the negative evidence. Men, even scientific men and philosophers, have been convinced for ages that certain ideas were true; and yet were compelled at last to recognize their falseness.*"

Certainly, that is his own statement. That is a quotation from his own writings: "* * * compelled at last to recognize their falseness." That is exactly what is to happen to the evolutionary philosophy. In fact, that is what has happened to it more than once already.

Instead of having been born with Charles Darwin in 1859, this doctrine was in great vogue six hundred years before Jesus Christ was born. Those old Greeks originated and taught it. It was one of their favorite philosophies. But it perished from sheer weakness, and was blotted out of sight and forgotten for more than two millenniums, and then, Charles Darwin's grand-father, old Erasmus, began to give it expression. Charles gave it voice and in the present-day teaching it is screaming aloud. But greater activity is not always evidence of life.

I was brought up on a farm, and I have cut off the head of many a chicken, and I have seen him far more active when his head was off; he was dead but he did not know it. That is the exact condition of this thing at the present time. It is in its death throes. I am here tonight to just give it another little tap and put it out of its misery. (Applause.)

Let me say that all scientific men are not agreed on this subject. On the other hand, there never was a subject before scientific men on which there was such confusion. You can take any single point by which this system is built up, and there are no two outstanding men that will agree upon it.

Start, if you please, with "the origin of things!" They are not agreed at all. Take up the subject of "natural selection!" They are not agreed there. Not at all! You have the Darwin notion; you have Marx's; you have the McCabe notion, and no two of them are agreed.

I have tried, in every debate that I have met my opponent, to force him to employ arguments that are used in the textbooks of the schools at the present time,

and I can't get him to do it. I dare him to take up those arguments, the arguments that are taught these boys and girls here, viz., "spontaneous generation," "Natural selection," "Recapitulation," etc. I stand ready tonight to quote textbooks and refute every one of those steps by which this system has been built up. I challenge him tonight to take up any one of them.

Now, he has touched very slightly upon two or three of them, one of them seldom found in the textbooks, but the other two prevalent everywhere. Let me take up two or three that he has touched so lightly.

First of all, he said that the distribution of animals and plants over the world absolutely agrees with the law of evolution.

A statement is not a science. That statement is absolutely without proof. On the contrary, it is opposed to reason even. If what these gentlemen believe to be so is so, and sometimes, somewhere (nobody knows when, nobody knows where, nobody knows how) life came to a single cell, that cell would have been located and, in consequence of that fact, the continent on which the birth takes place would have been covered and peopled and other continents left bare.

We find nothing of the sort. There isn't a single thing in the creative record in Genesis that indicates that God only made one blade of grass. Not a thing. There is not a thing to indicate that God started life in one place only. On the contrary, the whole earth-record plainly shows that he filled the earth with plants and birds and fishes and animals from the beginning, even as the statement is made; and so I say that this distribution of plants and animal life is in absolute

accord with the creative theory, and has nothing in common with the evolutionary philosophy.

Now, he calls our attention to two continents and asks the question why? It is very easy to answer that. Why was there nothing found in New Zealand above the Tuatara? And why was there nothing found above the Kangaroo in Australia? Well, I would like to turn that question back upon him. If his law is operative, it ought to operate in those continents, as well as in others, and the higher forms should have been found.

If, on the other hand, the deluge record in Genesis is true, death might have ensued there very easily and most completely, and the animals and birds that were have been destroyed and swept away from that place.

Do you not know that from Key West clear up here to south of Baltimore there is a deposit of bone substance, simply millions of tons in extent, that cannot be accounted for in any way, known to the mind of man, except to admit the Genesis flood, and that the animals that were destroyed on the continents were swept around with the water until they struck land and piled up in heaps on both sides of our continent, as is the testimony? So his argument turns back upon himself, and I ask him to explain.

Again, if I were advocating a law that had been paralyzed, as he says in one of his books, 250 million years ago in New Zealand, and 200 million years ago it had another stroke in Australia, I would be afraid that the old thing would have a third stroke and perish on my hands! No reason in the world why the law should not be operative there if it were operative anywhere.

(To be continued in the next issue.)

FUNNYMENTALS.

The New York debate has made more evident to this editor than ever before that those meek-eyed, modernistic professors who are teaching this philosophy (evolution) to beardless boys and immature girls, are sowing the seeds of anarchy. Seldom in a lifetime will one face a company of people more prejudiced in thinking, more opposed to all moral and ethical ideals, more ready to hiss the name of God and consequently so ready to oppose all authority and government as this assemblage of New York atheists and agnostics proved to be. If evolution continues to be taught in America until a generation becomes infected with it, we will reproduce for our country the Russian experience and in a few years, by bloody revolution, Bolshevism will be in control.—Rev. Wm. B. Riley in *The Christian Fundamentalist*, March, 1929.

Here is my definition for evolution: Evolution is the theory that sometime, somewhere in the illimitable past by a fortuitous combination of non-entities, something emerged from the little end of nothing, by the inherent power of resident forces.—Rev. C. H. Cotton in *The Defender*, March, 1929.

Man cannot be the offspring of any kind of animal. Man is *sui generis*. He is directly created in the divine image, and that is what gives him his uniqueness. This

is proved by the fact that Adam could not find "a help meet for him" among any of the animals of the Edenic garden (Gen. 2:20). This theory of man's evolution from an animal pedigree is a crude theory, anyway, and arises from earthly thinking.—*The Bible Champion*, March, 1929.

In speaking of man in connection with animals it is better not to speak of "lower" animals, implying that man is an animal, but only one of higher degree or kind. Man has many factors in common with vegetable life; why not call him a vegetable, only of a higher kind? He has much in common with the inorganic realm; why not call him a clod of a somewhat higher order? No; man is *genus homo*; he belongs to an order of his own. Man has more fundamental elements in common with God and the angels than he has with the animals.—*The Bible Champion*, March, 1929.

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EVOLUTION

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In this Issue—

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How the Shark Gave Man His Teeth

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Brains — How Come ?

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Amphioxus

PHILIP H. POPE



Rhesus Monkey—Mother and Babe

Are There "Missing Links" in Plants?

By RALPH H. CHENEY

THE steps by which plants evolved are made clear by the similarities of structure between ancient fossil plants and their living kin of today. In the March issue of EVOLUTION, Dr. Florence D. Wood has already shown that the relationships within the basic plant groups can be definitely worked out from living forms. But to trace satisfactorily the descent of one major group from another requires the help of the fossil record, which, fortunately, is quite adequate. The missing links are in fact very few.

The anti-evolutionists often make much of the apparent absence of connecting links between the major groups of animals, but they cannot complain on that score as far as the plants are concerned. For the fossil plant record is singularly complete. This difference between the animal and plant records can readily be explained by the fact that nearly all the basic groups of animals had already evolved at the opening of the Cambrian period when our better preserved fossil record begins. On the other hand, all but the lowest of the great groups of plants have arisen later, in the time covered more or less adequately by the geological record, so that we can demonstrate quite clearly each transition from group to group. The story of the development of the four major groups of plants, one from the other, is well substantiated by several parallel lines of evidence, fossil and otherwise.

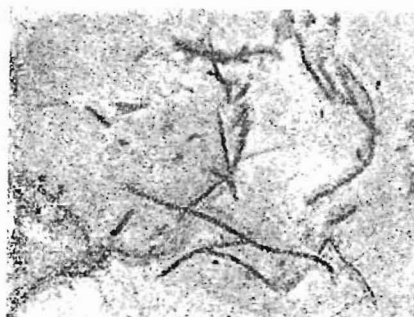
Each living species of plant is, of course, descended from older forms, but these ancestral forms may or may not have survived to the present day. In view of all the vicissitudes to which fossils are subject, it is unreasonable to expect always to find in fossil form the direct ancestors of living species. Most evolutionary series represent merely the structural stages through which the plant kingdom has passed in producing the more complex and modern types of plants. The record is most complete for recent forms, but there are also numerous fossils of the lower forms, in fact a rather surprising representation when we consider the almost incredible age of these forms and the many destructive geologic upheavals to which they have been subjected since their time. Though it must be admitted that the remains of the Mosses are but fragmentary, the fact of plant evolution is well established by the abundance and completeness in detail of the fossil records proving the definite development of the Gymnosperms (cone-bearing evergreens) from fern-like seed plants and of the higher flowering plants from these Gymnosperms.

The earliest forms of life must have been plant-like organisms, for only plants can manufacture food-stuffs out of mere mineral matter, gases and water. It is to be expected, therefore, that the earliest fossils would be simple plant types, and so they are. In the Proterozoic deposits, from which no sure signs of animal life have yet come, have been found fossil bac-

teria and Blue-green Algae (one-celled or chains of cells such as pond-scum), these being also the simplest plants alive today.

Plants, as well as animals, lived only in the water during the earliest stages of their racial development. The Liverworts, the most simply constructed of all Mosses, were the first plants to develop sufficient protection against surface evaporation to solve the problem of existing on land. They lacked true roots or stems, their bodies consisting of flat, membranous masses that formed an overlapping, carpet-like mat covering exposed areas. This important step from water to land was probably taken early in the Devonian.

In their further progressive evolution, the plants left a fossil record of achievements in structure which accords well with the order of development inferred from the evidence of living structures. During the



Fossil Bacteria a Billion Years Old.
(Magnified 180 diameters)

THE PLANT FOSSIL RECORD

(READ FROM BOTTOM UP)

(Figures show millions of years ago)

GEOLOGICAL AGES		When the major plant group records began
ERAS	PERIODS	
Cenozoic.	2 Quaternary	
	60 Tertiary	Flowering plants became dominant.
Mesozoic.	125 Cretaceous	Angiosperms (flowering plants).
	155 Jurassic	
	190 Triassic	True pines.
	215 Permian	
	Upper Carboniferous (Pennsylvanian)	First Gymnosperms (pines, etc.). Cycad (sago palm). (Age of giant ferns, club mosses and horsetails.)
Paleozoic.	Lower Carboniferous (Mississippian)	
	400 Devonian	Seed ferns. True ferns. Club mosses and horse-tails. Woody stems. Liverworts and true mosses.
	Silurian	
	Ordovician	
Proterozoic.	720 Cambrian	
	Keweenawan.	Algonkian---Brown algae (seaweeds).
	Animikian.	
	1200 Huronian	Blue-green algae (pond scum). Bacteria.
Archeozoic.	Sudburian	
	Keewatin Grenville	



Early Devonian Land Plant: (a) Spore Cases, (b) Spine-like Leaves, (c) Wood-Cells of Stem



Upper Devonian Seed-Fern



Typical Forest of Carboniferous Giants

Devonian period notable advances were made, such as the development of woody stems for support (with their water conducting "pipe-lines"), and true leaves. From the simpler woody-stemmed, but quite leafless ancestors of the ferns in Devonian strata, we can trace the steps to the forests of giant Club Mosses and Horsetails of the fern family found so abundantly in the Carboniferous coal measures. Already in Upper Devonian times, seed-ferns had developed from the

true ferns, and these seed-ferns through a definite fossil series gave rise to the modern cone-bearing Pines and other Gymnosperms. The flowering plants (Angiosperms) first appear in the middle Cretaceous only eighty million years ago. The fossil remains of our modern major plant groups therefore appear in the same geological order as the complexity of allied present forms would demand. The fossil record convincingly establishes the fact of plant evolution.

How the Shark Gave Man His Teeth

By MAYNARD SHIPLEY

AS the sharks are the lowest family of true vertebrates in the line of man's ascent, it is not surprising that man inherited the shark's teeth along with his spinal column, which in the shark's case is made up of segments of cartilage.

Perhaps this article should have been entitled, "How the Shark Got His Teeth." As all the higher vertebrates got their teeth from the shark, what we need to learn is where he got the teeth he bequeathed to us.

We know no animal before the shark that had true teeth, such as could develop, through the ages, into those of the apes and man. So the earliest sharks could not inherit their teeth but had to develop them.

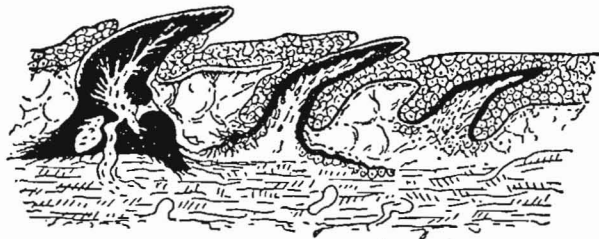
But everything in this world has developed from something pre-existing. There could not have been land animals with lungs unless there had been fishes with swim-bladders; and if reptiles had not had scales, the birds that followed would not have had feathers. And so, to get back to teeth, had there been no fish with tooth-like (placoid) scales, there might have been no fish or other animals with teeth like ours.

It happened some four hundred million years ago in Devonian times, when much of the interior United States was an inland sea. Abundant fossils found there tell us the waters were prolific with sharks, especially with one family which the scientists give the jaw-breaking name *Cladoseiachidae*. There still flourish, along the Atlantic Coast, sharks closely akin to them. These modern survivors have also been given a name to tax the articulating mechanism of the tired business man, but we shall call them dog-fishes for short. It

was the ancestor of the spiny dog-fish who developed real teeth, all over his body, from his placoid scales.

"But," someone objects, "teeth don't grow all over the body—thank heaven!" No, but the early Cladoseiachian grew his scales all over the body and right over the snout and into his mouth where they became teeth. In fact these scales were real teeth. For if you could conveniently coax a shark ashore, extract one of those teeth and compare it under the microscope with one of your own, this is what you would see:

These teeth within the shark's mouth are of course greatly modified, but in origin and structure they are similar to the scale spikelets all over the body. Beginning with the horny layer that covers the spikelet, we come next to a layer of tall, column-like cells, set at right angles to the surface of a lower layer of genuine enamel—in fact these columnar cells secrete the enamel—the hardest substance in animal bodies. In the higher animals, this enamel is only found as the covering of the dentine of the teeth. The dentine of



Spikelet Teeth (Shagreen Denticles) of Modern Shark Breaking Through Skin of Mouth

the spikelet surrounds a pulp-like cavity and is formed of hardened, bone-like skin tissue which contains no cells. The sensitive connective tissue in the pulp-cavity sends processes into the dentine, the dentine canals.

Such is the description of the spikelet on the shark's body. But it is also the description, so far as it goes, of the tooth of man, from the enamel down. And if we follow these spikelets over the shark's nose and down into his mouth—being sure, of course, that the shark is well dead—we will find that there they will develop from the skin inside the mouth just as they did on the shark's sides. Through millions of years of variation and natural selection they have gradually

flattened (some at least) into blade-like cutting teeth with serrated, or saw-like, edges. Often, too, several teeth are fused into one, developing from a deep fold of the skin lining the mouth.

In mammals there is also a deposit of cement on the root and sometimes also on parts of the crown. But in no animals do the teeth form any real part of the bony framework. Like hair, fur, scales, feathers, horns and nails, they originated in and developed from the skin. And in all animals higher than the shark, the teeth, however profoundly modified by millions of years of evolution, still bear clear traces of their descent from the tooth-like scales of a family of Devonian sharks.

Brains—How Come?

By ALLAN STRONG BROMS

VII

MAN brags about his gray-matter. Rightly so, for it's his big asset. But the other animals, apes especially, have a lot too, only not enough. Gray-matter is the switchboard of man's nervous and thinking outfit, and he has won over the other animals by adding a lot to the board.

Under the microscope, gray-matter shows up as a myriad nerve-cells bristling with fine branches. These branches make the contacts for plugging in connections on this most complicated of all switchboards. Complicated! Man has nine thousand million nerve-cells in his brain alone, each with a lot of branches.

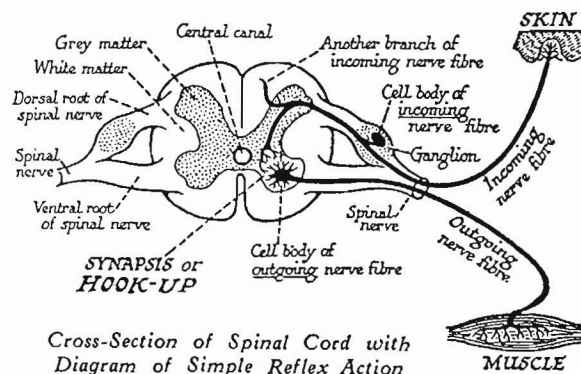
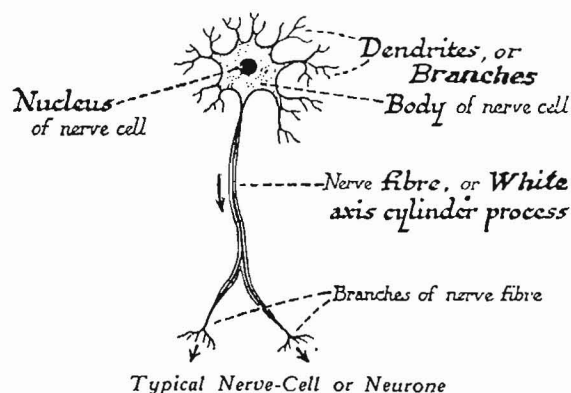
Another kind of nerve stuff, the white-matter, consists of long fibres, really long-distance wires to and from the gray-matter nerve-cells. Their business is to carry messages in and out, fact messages inward from sense organs (eyes, ears, nose, tongue, skin) and orders outward to muscles and glands that do the body's work.

An unborn human baby starts off with a brain and nervous system consisting of a mere tube or cord running the length of its body and tail. Some early fish ancestor had no more, just a simple spinal nerve cord to keep head and tail in touch and working together. But the head end, with its mouth, nose, eyes and many contacts, had much business to keep in order, so its end of the nerve cord swelled into a brain-knob, a central headquarters. As time went on, headquarters made new outside contacts, through ears for in-

stance, and took on new jobs, such as talk. So the brain-knob grew big and complex and expanded in new directions. And the baby brain, in its few months of growth, sums up this evolution of our ancestral brains which gave man such a swell head.

But the brain did not take on all the jobs. Some were just local and so simple that the gray-matter down in the spinal nerve cord could better handle them. When your finger touches fire, a white nerve brings in the alarm. Usually the local spinal-cord station in charge of your arm takes care of it, shoots out an order over a second white nerve to "take it away," and the muscles do just that. Meanwhile a third white nerve relays the alarm to headquarters and you *feel* it. Of course, if it's a real four-alarm fire, headquarters takes charge, to do some tall cussing, put out the fire, or yell for help. But usually the alarm is just reported with the good word, "already handled." This local, automatic handling, just in and out, just sensing and doing, is called *reflex action*. The lowest animals depend on it; even we use it a lot.

Gray-matter at headquarters is spread out thin over the wrinkled surface of the big top brain we call the *cerebrum*. Really in sections, each with its own business to handle, the gray-matter all looks alike. Within each section the short nerve-cell branches make local hook-ups, but between sections long-distance white nerves make the connections. These nerves are inside and behind the big switchboard, masses of white fibres, some joining the board parts together, others bundling



into nerve cables that lead out to sense organs, to lower brain centers, to the spinal-cord and the body works. Through the white nerves the brain keeps in touch with outside happenings, gets together its ideas of what to do, and sends out its instructions to the doing organs.

It looks like a great apparatus, but how can that apparatus think? Just watch.

Build a strong, high, mesh-wire fence. Put a hen on one side, chicken-feed on the other. The hen sees, wants and acts—through eye, white optic-nerve, gray-matter hook-up, white motor-nerve, the muscles that act. But the hen hits the fence, fails. She tries again, the same way, fails again. Her hen brain knows just one way, her limit. So she does not eat.

Put a dog on one side of the fence, dog-feed on the other. The dog reacts like the hen, bumps into the fence, fails the first time. It tries again, but in different ways. For its gray-matter has several hook-ups. It tries all ways, one after the other—jumping over, digging under, breaking through, running around the end. At last one way works. The dog eats. The next time it does the right thing sooner. After several times, does it first. The right gray-matter hook-up has become *habit*.

Now put a man on one side, his food on the other. He sees, wants, and goes after it. He acts too, but not with his body, not yet. He acts first in imagination. One way after another. For his gray-matter also hooks

up in several ways. One urges, "climb over," but an idea stops the urge. "Too high." That idea just came in over another hook-up from the eyes. A second cell urges, "dig under," but another idea blocks it, "ground too hard." Urges to break down, reach through, forget it, are all blocked by obstructing idea hook-ups, and none go into action. But one urge, "go around the end," is not blocked. Through eyes, white nerves, gray-matter, comes the information that the fence is short. That goes with the urge, not against it. So the urge goes through, into action, with success. The man eats. He gets results, quickly, easily, without waste of physical action.

Every nerve message tends to become (reflexly) a nerve urge to act. The hen acted, one way only, was stopped physically. The dog acted, several ways, was stopped physically, except one way. The man acted too, in several ways, but in gray-matter tryouts first. His acts were stopped too, except one, but mentally, not physically. His were stopped by gray-matter "don'ts," by idea hook-ups that obstructed unpromising urges to action. We say he stopped to think. What he did was to act out his urges mentally to see if they would work. Only the workable urges went through into physical action. That way he saved time and effort. We call that *adaptive thinking*. Simple enough. Just some gray-matter hook-ups. But they made man master. He had more than the beasts.

The next article will be just "Talk! Talk!! Talk!!!"

The Earliest Bird

By FREDERIC A. LUCAS

WHEN we come to the topic of the earliest bird—not the one in the proverb—we are limited to the famous Archaeopteryx from the Solenhofen quarries of Germany, which at present forms the starting point in the history of the feathered tribe. Birdlike, or at least feathered, creatures must have existed before this, as it is improbable that feathers and flight were acquired at one bound, and so it may be that some of the three-toed tracks in the Connecticut Valley were really footprints of birds. Not birds as we know them, but still creatures wearing feathers, these being the distinctive badge and livery of the order. No bird is without them, no other creatures wear them, so the birds may be exactly defined in just the two words, *feathered animals*. The exclusive mark of birds is therefore not flight but feathers, though in penguins, the feathers have so changed that their identity is almost lost.

By putting various facts together we obtain some pretty good ideas regarding the appearance and habits of the first birds. The immediate ancestors of birds, their exact point of departure from other vertebrates, are yet to be discovered; at one time it was considered that they were the direct descendants of Dinosaurs, or that at least both were derived from the same parent forms, and while that view was almost abandoned, it

is again being brought forward with much to support it. It has also been thought that birds and those flying reptiles, the pterodactyls, have had a common ancestry, and the possibility of this is still entertained. Be that as it may, it is safe to consider that back in the past, earlier than the Jurassic, were creatures neither bird nor reptile, but possessing rudimentary feathers and having the promise of a wing in the structure of their forelegs, and some time one of these animals may come to light; until then Archaeopteryx remains the earliest known bird.

In the Jurassic, then, when the Dinosaurs were the lords of the earth and small mammals just beginning to appear, we come upon traces of full-fledged birds. The first intimation of their presence was the imprint of a single feather found in that ancient treasure-house, the Solenhofen quarries; but as Hercules was revealed by his foot, so the bird was made evident by the feather whose discovery was announced August 15, 1861. And a little later, in September of the same year, the bird itself turned up, and in 1877 a second specimen was found, the two representing two species, if not two distinct genera. These were very different from any birds now living—so different, indeed, and bearing such evident traces of their reptilian ancestry,

(Continued on Page 7)

The Lost Race of Neanderthal

By EDWARD GRIEG CLEMMER

THE Neanderthal race lived in the middle of the Old Stone Age, during the fourth glacial epoch when Northern Europe and England were covered with ice. In the arctic cold that swept down through Europe lived such animals as the lemming, muskrat and arctic fox, while the mammoth, woolly rhinoceros and reindeer roamed over England and France.

The rigorous winters drove Neanderthal man to the shelter of caves, making the preservation of his remains more certain. In summer, of course, he lived outdoors. Neanderthal man was also first to bury his dead, again insuring that his remains would be found by later generations.

The first Neanderthal skull, found at Gibraltar in 1848, got little attention. In 1856 another was found in a small limestone grotto in the Neander Valley, Germany, from which the race received its name. Other remains have since been found on the banks of the Thames, the Somme, Rhine, Danube, and Meuse, in Wales, France, Belgium, Italy, Germany, Spain, Switzerland, Austria, Poland, Russia, Asia Minor, Africa and Egypt, the wide distribution proving this to have been the dominant race of the time.

As these remains run from small fragments to practically complete skeletons, our reconstructions are based on facts. We do not have to rely on inferences drawn from scanty fragments, as we have to with earlier types of men. Here the whole story is laid before your eyes.

The race was short in stature, the men varying from five feet to five feet, five inches. A lone female skeleton is four feet, ten inches tall. The skull is very large for primitive men, with a cubical content almost equaling our own. The shape, however, is far from modern. The upper borders of the eye sockets formed a high ridge which must have given a very ape-like appearance. Back of this ridge, the low forehead sloped back very sharply. The front teeth, sloping forward, gave him a protruding mouth, further emphasized by the lack of a pointed chin.

Below the incisor teeth of modern man are short projections of bone which give attachment to certain muscles of the tongue. These muscles give the tongue great flexibility and thus make for highly developed speech. In the apes these bones are merely slightly rounded prominences. In Neanderthal man they were more highly developed, but

not yet as long and sharp as in modern man. This indicates a moderately developed organ of speech, permitting only a partially complete language.

The heavy, short backbone made only one curve from hips to skull. Our own backbones have an S-shape, a hollow at the small of the back, a protrusion at the shoulders and a hollow at the neck. All this helps absorb the shock when we land from a jump. The Neanderthaler had to break the shock by letting his head fall forward. Also the hole in the floor of the skull through which the spinal cord reaches the brain is set farther back than in moderns. Evidently, the neck sloped more to the front than our own. From the way the thigh bone met the shin and hip, we also know that Neanderthal man could not stand fully erect.

Sir Arthur Keith has made the interesting suggestion that perhaps the Neanderthal type was due to some peculiar working of the pituitary gland. It is one of the endocrine glands which secrete and pour into the blood stream certain substances called

hormones, chemical messengers which stimulate other parts of the body to do or develop in certain ways. When the pituitary gland, situated at the base of the brain, becomes enlarged in modern man, Neanderthal-like characters are developed in exaggerated forms. Hence Keith's suggestion that Neanderthal man was a "hormone" product.

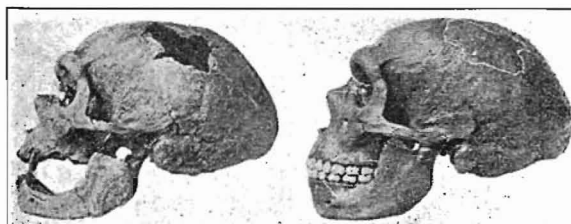
The tools of this race give us an insight into their everyday life. Their method of tool-making differed from those of preceding races. Instead of chipping down a large piece of flint to the desired form, the Neanderthaler struck off a number of chips and then selected the most likely, fashioned them further if need be, or used them as they were. Though not an advancement in skill, this was a great time-saver.

The two principal types of implements were the point and the scraper. The point was shaped from a triangular chip, the bulb end forming the base, the two sides tapering to a well-defined point. The sides, chipped finely, gave a single good cutting edge. The base, also made thinner, suggested that the points may have been hafted. This implement served as drill, punch, or point for knife or javelin. The sharp edge was used for knife blade, saw, or scraper.

The scraper type was shaped from non-triangular chips. Larger and rounded or ob-



*Neanderthal Man as
Restored
by J. H. McGregor*



A Fossil Neanderthal Skull—the Original and as Reconstructed

long, scrapers were retouched only on one side, the other being used for holding. Sometimes they were made into a sort of axe, both edges being chipped, but only on one surface. These may also have been hafted for a handle.

Crude, improvised bone tools, usually from the lower leg, were probably used for skinning and preparing the hides of animals. As bone is so perishable, we cannot be sure whether Neanderthal man used them more than stone for tools, but from the crudeness of the bone tools, we conclude that they were improvised and used only a few times before being discarded.

The experts agree that this race, once so widely prevalent, became extinct and left no descendants. Their place seems to have been taken quite suddenly by a new race called the Cro-Magnon, thought to have immigrated from Asia.

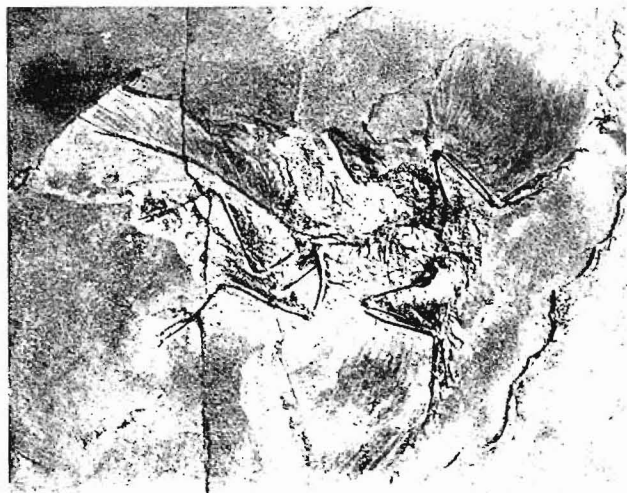
This is third of four articles by Mr. Clemmer on The Ancestors of Modern Man, the next being on The Cro-Magnon People.

The Earliest Bird

(Continued from Page 5)

that it is necessary to place them apart from other animals in a separate division of the class birds.

Archaeopteryx was considerably smaller than a crow, with a stout little head armed with sharp teeth (as scarce as hen's teeth was no joke in that distant period), while as he fluttered through the air he trailed after him a tail longer than his body, beset with feathers on either side. Everyone knows that nowadays the feathers of a bird's tail are arranged like the sticks of a fan, and that the tail opens and shuts like a fan. But in Archaeopteryx the feathers were arranged in pairs, a feather on each side of every joint



Earliest Known Bird, *Archeopteryx*, Impressed on Sandstone Slab

of the tail, so that on a small scale the tail was something like that of a kite; and because of this long, lizard-like tail this bird and his immediate kin are placed in a group dubbed Saururæ, or lizard-tailed.

Because impressions of feathers are not found all around these specimens some have thought that they were confined to certain portions of the body—the

wings, tail and thighs—the other parts being naked. There seems, however, no good reason to suppose that such was the case, for it is extremely improbable that such perfect and important feathers as those of the wings and tail should alone have been developed, while there are many reasons why the feathers of the body might have been lost before the bird was covered by mud, or why the impressions do not show.

It was a considerable time after the finding of the first specimen that the presence of teeth in the jaws was discovered, partly because the British Museum specimen was imperfect (the skull was lacking, and a part of the upper jaw lying to one side was thought to belong to a fish), and partly because no one suspected that birds had ever possessed teeth, and so no one ever looked for them. When, in 1877, a more complete example was found, the existence of teeth was unmistakably shown; but in the meantime, in February, 1873, Professor Marsh had announced the presence of teeth in the diving bird *Hesperornis*, so to him belongs the credit of discovering birds with teeth.

The first discovered specimen of *Archaeopteryx* is in the British Museum, the second and more complete example is in the Royal Museum of Natural History, Berlin, and is here shown on its stone slab.

AMPHIOXUS

(A song to be sung with the well-known chorus)

Tune: "Tipperary."

I

A fish-like thing appeared among the annelids one day.
It hadn't any parapods or setae to display.
It hadn't any eyes or jaws, or ventral nervous cord,
But it had a lot of gill-slits and it had a notochord.

Chorus

It's a long way from Amphioxus, it's a long way to us,
It's a long way from Amphioxus to the meanest human cuss.
Good-bye fins and gill-slits! Welcome lungs and hair!
It's a long way from Amphioxus, but we came from there.

II

It wasn't much to look at, and it scarce knew how to swim,
And Nereis was very sure it didn't come from him.
The Molluscs wouldn't own it and the Arthropods got sore,
So the poor thing had to burrow in the sand along the shore.

Chorus

III

It wriggled in the sand before a crab could nip its tail.
It said "Gill-slits and myotomes are all of no avail.
I've grown some metapleural folds, and sport an oral hood,
But all these fine new characters don't do me any good."

Chorus

IV

It sulked awhile down in the sand without a bit of pep,
Then stiffened up its notochord and said, "I'll beat 'em yet.
I've got more possibilities within my slender frame
Than all these proud Invertebrates that treat me with such shame."

Chorus

V

"My notochord shall grow into a chain of vertebrae:
As fins, my metapleural folds shall agitate the sea.
This tiny dorsal nervous tube shall form a mighty brain,
And the vertebrates shall dominate the animal domain."

Chorus

PHILIP H. POPE.

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develop the open mind by popularizing
natural science*

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JULY, 1929

SKIP MAY AND JUNE

Again we "skipped," we hope for the last time. All subscriptions will, of course, be extended for two months to replace May and June. Every yearly subscriber receives full twelve numbers.

IS EVOLUTION A CREED?

"Evolution is a religion," say the Fundamentalists, "and should therefore be barred from the schools." They claim that the origin of man and this world is a problem for religion alone and that any attempt at solution by scientists becomes perforce religious.

Certainly the religious have tried their hands at the problem and have given answers aplenty—but variant and contradictory. All (but perhaps one) must therefore be wrong. Yet each quotes divine authority and demands unquestioning faith. Thus they are mutually intolerant, which is the real reason for barring all teaching of creeds from the schools. If one be taught, all must be taught; but if all be taught, they contradict and only weaken faith. So wisely they have agreed to forebear and teach none at all. The result has been happy, it has kept out a lot of mental rubbish.

Now science employs a different method, the testing of each account by its agreement with the whole body of ascertained fact. Facts are ascertained when they are verified consistently by experiment and observation. Of course, if the problem of origins were, of necessity, exclusively religious, whatever the approach, then certainly evolution would become religion. But if it be a proper problem for study by any result-getting method, then science cannot well be barred just because the religions have made attempts in the same field. Nor should it be barred because its answers differ from those the creeds demand. For the essence and value of the scientific method lie in its free acceptance of the con-

clusions to which the facts of observation lead. And if the method is valid elsewhere, it is valid here.

After all, what really worries the Fundamentalists is that the conclusions of science contradict their sanctified guesses. And it is quite too late in this age of practical science to deny and defy the scientific method—it works too many useful wonders. So resort must be had, if the creeds are to be saved, to devious argument and confusing appeals. So we hear that science (in the form of the evolution theory) is religion because it confounds the creeds, and must logically and fairly be barred from the public schools. The argument has a shallow appeal. It would be logical and fair—if it were true.

But it is not true. Evolution is not a religion. It is a conclusion quite unanimously reached by the scientists of the world on the evidence of the known, pertinent facts. And it is taught, not as an article of faith, to be accepted on divine authority, but as a conclusion which may be drawn from an examination of all the facts that careful research reveals. The student is not asked to accept it blindly, to suppress the doubts, to profess it eagerly. He is asked to examine, to weigh, to test, to judge for himself. He is taught to use his own mind, to derive his own conclusions. That makes for clear, independent, useful, honest thinking. It is the way to mental health, to sound progress, to the truth that shall make us free.—Allan S. Broms.

WORLD LEAGUE FOR SEXUAL REFORM

The World League for Sexual Reform will hold its Third International Congress in London during the week of September 9th-13th, 1929. The aim of the League is to "establish sexual ethics and sociology on a scientific, biological and psychological basis." The subjects to be discussed at the Congress are:

Marriage and Divorce

Birth Control, Abortion and Sterilisation

Sex and Censorship

Venereal Disease and Prostitution

The presidents of the Congress are August Forel, Havelock Ellis and Magnus Hirschfeld. Eminent scientists from many countries are expected to contribute to the programme. The American participants include Dr. Harry Benjamin, Dr. William J. Robinson, Margaret Sanger, Dr. A. A. Brill, Upton Sinclair, Dr. Hannah M. Stone, Dr. Abraham Stone and Dr. S. D. Schmalhausen.

Further particulars about the Congress may be obtained from the Secretary, Dr. Norman Haire, 127 Harley Street, London, England.

IF YOU CHANGE YOUR ADDRESS

for the summer, give us your old, as well as your new address, and specify for how long. Of course, we hope your letter will also contain some new subscribers.

CORRECTIONS

An error for which the author was in no way responsible occurred in the article on "The Origin of Man from the Anthropoid Stem" by Dr. Wm. K. Gregory in our last issue. The caption under the illustration should have been "Hand bones of Man and Gorilla," not Chimpanzee, and credited to Haeckel.

Also in the article on "Brains—How Come?" by Allan Strong Broms the printer made brain "convulsions" out of "convolutions." Beg Pardon.

INVEST IN EDUCATION

The following friends have invested in this educational enterprise since last report:

M. M. Cox, \$12.00; L. T. B. Light, \$200.00; A. Radesinsky, \$10.00; Geo. Welby Van Pelt, \$1.00; Henry Field, \$10.00; H. J. Shelton, \$2.00; Ellen R. Nagle, \$5.00; Thos. L. Brunk, \$1.00; Aaron Levy, \$10.00; Grace Potter, \$120; B. Goldberg, \$10.00; J. Ganau, \$5.00; Frances Pilat, \$5.00; Bertha Howe, \$1.00; W. Gordon, \$1.00; Geo. H. Parker, \$10; E. S. Wertheim, \$5.00; Anna Johnson, \$1.00; O. C. Harris, \$1.00; J. C. Nietzsche, \$1.50; Joe Kasper, \$1.00; Nancy I. Beebe, \$5.00; Alfred Sorenson, \$1.00; Harry Lashkowitz, \$1.00; M. Mark, \$30; Martin Dewey, \$200.00; Paul Metzko, \$1.00; Chas. Fuchs, \$5.00; Henshaw Ward, \$20.00; Frank A. Sieverman, \$300.00; A. M. Sieverman, \$60.00; A. Friend, \$25.00; W. R. Wharton, \$4.50; Total, \$1,065.00.

Continuation of this splendid support will enable EVOLUTION to become an effective instrument for popular enlightenment. For every ten dollars paid in a share is issued. Every reader is invited to become a shareholder.

WELCOME, QUEEN SILVER

After a lapse of two years Queen Silver's Magazine appears again, frank and fearless as ever. Her article on "Science versus Superstition" in the May-June number is particularly refreshing. Her rate is 50 cents a year. Address: Route 1, Box 720, Hawthorne, California.

CROWDED OUT

Our feature page "The Amateur Scientist" which is crowded out of this issue by the debate, will appear again in our next.

MORE TRUTH THAN POETRY

The Bible story of creation
With the late plan of salvation
From eternal hot damnation
Leaves the mind in obfuscation.

But from the story of Evolution
Can be drawn a sane conclusion
With very little of confusion—
Then the mind's not in occlusion.

M. MARK.

McCabe-Riley Evolution Debate

Second section of the Debate held at Mecca Auditorium, New York, February 7, 1929, between Professor Joseph McCabe, of England, Science Popularizer, and Reverend W. B. Riley, President of World's Christian Fundamentals Association, on the question: "Resolved That Evolution Is True and Should Be Taught in the Schools." This is continued from our last issue, in which Professor McCabe's first speech and the opening of Dr. Riley's first speech appeared.

REV. WM. B. RILEY (continuing): Then, he did touch slightly upon vestigial remains, those 180 whatever you want to call them, in your body that have no function. I thought I taught him better in the previous debates, and I felt every time he went down to defeat that he wouldn't do that thing again. (Laughter.) But if he won't learn, I will have to instruct him afresh tonight.

Now, I just want to take up tonight a few of those vestigial remains. For instance, let me call your attention to several of them just at this point in my argument. Vestigial remains—what are they? What vestigial remain is there in the human body that has no function? I wish he would just tell me that. And then I can take up that particular one and give attention to it. But, lest he might not get to them, I will give attention to a few of them just in passing.

Take the appendix! The average man has that cut out, because the modern scientist (?) has told him that it has no function, and the physician is perfectly willing to accommodate him for a few dollars, or several, as the case may be. So he has it cut out.

Let us see whether it has a function or not. Dr. Howard Kelly of John Hopkins University, one of the first authorities in America, says this: "It increases the extent of the intestinal mucous surface for secretion and absorption and is very valuable." (Applause.) All right. There is your answer to that.

A few years ago the thyroid glands were called useless glands. They are located on either side of the windpipe, just below the larynx. It is now conceded by Dr. Vincent that "defective thyroid function, in the mother, is the essential factor in the production of cretinism." You know that effects both body and mind! Dr. C. W. Saleeby says: "It provides iodine for the body without which no man can live. Without enough of it in the blood, an expectant mother is imperiled, and her babies cannot be normally born." He further says that "the thyroid saves a vast amount of ugliness, idiocy, deaf-mutism, and possible cancer."

Some years ago I was on the train going out to the Pacific Coast. I picked up a paper. Professor Lull of Yale University had an article in it in which he spoke of another vestigial remain, namely, one that is found in the head known as "the pineal gland." It is located on the top of the head. It is a little organ about the size of a grain of wheat, located in the roof of the third ventricle of the brain.

Now, Lull said that undoubtedly that was the remains of a single eye left over from one of our mud-

loving ancestors. He had that one eye so that he could wallow himself in the mud, and leave that eye above and look around and see if there was any danger approaching. (Laughter.) That is exactly what he said. I have the Doctor's article at home.

Dr. Swale Vincent, professor of physiology in the University of London, says that "the pineal gland is the most important organ in the human body and regulates entirely the growth of the body itself and determines especially sexual development; it also controls the inflow and the outflow of the cerebral fluid and cannot be dispensed with."

Doubtless, when we know more, we will discover that God didn't make as many mistakes as we imagine, and that every single feature, natural to the human body, was divinely appointed and has important functions to perform. It is too bad that my friend McCabe was not there when God was making Man so that he could have told him a lot of things to leave off.

Do you know, if there is any one thing that I would call a vestigial remain, it is my finger nail. We do not claim its usefulness since climbing is no longer our animal custom. According to the McCabe view, we do not need it. We don't run on the ground as the hogs do. Why the nail? I smashed my thumb six months ago, and the nail hasn't grown perfectly as yet, and I can't open my knife.

I tell you, there are no vestigial remains! Every single part of man functions! I want to tell you that I never had a particle of my body cut away. Not a thing! I still have my appendix. I have my tonsils. I have everything that God gave me, and they all function. That is why I beat the Professor so often.

Now, I want to call your attention, in passing tonight, to another thing, and that is this: that when the Professor would have you believe that all these people are absolutely agreed, he is just playing with you; that is all. I'll show you how far they agree.

The Professor believes and teaches in his books everywhere that we came up from animal life, and that we have a bestial pedigree, first, and then it runs clear down to the fishes, to the gill slits. Yes, he actually believes that, and that is what they teach you young men and women in school!

I challenge any physician living to tell me that there are gill slits in the human foetus. The human foetus is never, never at any stage characterized by gill slits. I come of a line of physicians. My brother is one, my sons are physicians. There are no gill slits in the human foetus! I dare you to say that there are, and I will go and disprove it in the laboratory.

Professor Huxley asked a student one day: "What is a lobster?" The student said: "A lobster is a red fish that moves backward."

Professor Huxley said: "That is a very good answer but for three reasons: It is not a fish; it is not red, and it does not move backward. Aside from that your answer may stand." (Laughter.) So of human gill slits. They are neither gills nor slits, but folds only!

I suppose that most of you have had your attention called lately to what Professor Austin Clark said a little while ago. Professor Austin Clark is a graduate of Harvard University. He was sent on that zoological Venezuela research expedition in 1901. In 1903 he went to the Lesser Antilles on a kindred expedition. He is a member of the Royal Geographical Society, and since 1908 of the Smithsonian Institute staff.

Now, listen to what he has to say (reading): "So far as concerns the major group of animals, the creationists seem to have the better of the argument. There is not the slightest evidence that anyone of the major groups arose from any other. Each is a special animal—complex—closely related to the rest, but appearing as a special and distinct creation."

Professor La Conte of the Pacific Coast, one of the finest scientists we have had in America, said years ago (reading): "The evidence is now that these species appear, exist for a certain time, and pass away, to be succeeded by other of a wholly different character and never by transmutation." And when you take transmutation out of this doctrine, it collapses of its own weakness, as Spencer and others said of it.

I have never been parading the virtues of Henry Fairfield Osborn. I cannot forgive him the Hall of the Age of Man. It is a hoax, as I am able to prove.

But, I am going to quote from Professor Osborn and from your Herald Tribune of recent date. Just listen to this (reading): "The causes of evolution will probable never be known to us any more than the causes of gravitation.

"Science is coming up against a blank wall in biological sciences and when we do, our studies will be restricted to modes and processes of evolution which we know to exist. If the bones of a man that existed 15,000,000 years ago are ever dug up, they will be of a man which has as fine potentialities, fine hands and limbs, not different from ours. Man has his own ancestry."

Now, listen to this (reading): "We are rapidly coming up against a blank wall in biological science." How can it be otherwise when they have followed a false trail?

Mark again. "If the bones of a man that existed 15,000,000 years ago are ever dug up," etc., what a combination of sense and non-sense! Sensible in denying monkey ancestry and so repudiating the hoax, "The Hall of the Age of Man!" Nonsensical in supposing man existed 15,000,000 years ago, "if he isn't dug up." Yes, if he ever is! These gentlemen simply deal in pure suppositions.

Mr. Darwin, in two of his great works, uses suppositions over eight hundred times, and an unlimited series of suppositions do not constitute a science. "Science is knowledge gained and verified by exact observation or experimentation and especially as related into a rational system," and with that definition this doctrine of assertions has no kinship.

Now, on that last sentence I agree with the gentleman, and as for the first, I will just wait until he digs up the bones of fifteen million years ago, and then I will agree with him on that.

Don't impose upon my children a doctrine that has nothing but supposition as a basis for it. (Applause.)

I have no objection to teaching the truth. All truth is in harmony, absolute harmony. No truth can clash with another truth. That would dethrone God himself. But I object to the teaching of a false science, a science falsely so called in the name of truth.

And I particularly object to imposing that upon the minds of the children of parents and taxpayers who know it be false.

It is quite the custom now to call anti-evolutionists backwoodsmen, ignoramuses, and all the other nice terms that they apply to us. But does that prove anything? I want to ask you whether that question is vital to the subject at all or not. We believe in a free government in this country, do we not?

I have visited in Tennessee since I was a lad, for I was brought up fresh over on the Kentucky side. I have not known a sweeter and more cultured people in my somewhat extended travels than I have found in Tennessee. I have spent some weeks in Arkansas in the last year. The Arkansan is what these evolutionists are denouncing now as ignorant hill-billies!

Ignorance is now located in Boston and vicinity. You Boston people will forgive me, for you are the exceptions.

But look what you have around you in all your factory towns, and you will no longer parade the intellectuals of the hub. No longer. Arkansans and Missisippians are not what they are being called. They are intelligent folk.

And if they were as ignorant as the evolutionists make them out to be, would you deprive them of the right of ballot? They decided whether they wanted imposed upon them a doctrine which they do not believe and a doctrine which they believe is absolutely detrimental to all morality. Is not that the sovereign right of any free people?

You wipe out God of existence in the mind of man, as this philosophy does it, for it is atheistic by nature and character, and you wipe out the decalog—the basis of all law!

There isn't a man that believes in the doctrine of evolution thoroughly and at the same time holds to the divinity of the law as recorded in the Old Testament book, the basis of all law in all the world.

When you wipe out God, you wipe out the law, and when you have produced a lawless people, you have produced a criminal people at the same time. (Applause.)

* * *

THE CHAIRMAN: Professor McCabe will now speak for twenty minutes. (Applause.)

PROFESSOR JOSEPH McCABE: Your Honor, ladies and gentlemen: You New Yorkers have heard what it is that has moved Arkansas and Tennessee and Kentucky. I say that you have now heard in New York and I will not say what arguments, but on what kind of rhetoric Arkansas and Tennessee have been moved to delete evolution from their textbooks.

During the time that Dr. Riley was talking to you he entirely ignored every argument that I used. (Ap-

plause.) I gave you a clear, intellectual outline of the position of scientific men, not of one scientific man here and there. I don't talk to you of the men of twenty-five or thirty years ago. Thirty and forty years ago there were certainly obscure points in science. What is it to you to go back thirty or forty years ago and discuss what differences there were between scientific men of that time?

The proposition I lay before you tonight is that for the last twenty-five years at least all the scientific men in the world are agreed upon the fact of evolution. Against those scientific men are only a few ministers of religion, and I submit tonight that their arguments are not even respectable. (Applause.)

But, as our time is short—Dr. Riley wishes this debate short, because he must go away tonight; I was hoping to have still another half an hour, but you understand, he wishes to curtail this debate, and then he will have twenty minutes for jokes, and I will have five minutes to wind up the whole talk.

Why could not Dr. Riley address himself intellectually to the case that I put before you? Why not? I put before you five lines of evidence on which all the scientific men in the world are agreed. And I most particularly want to know what is the meaning of the convergence, the coincidence, of those five lines of evidence? That from the scientific point of view is one of the weightiest arguments that you could possibly produce. Not one single word was said about it from beginning to end. I take, therefore, just a few points that Dr. Riley made.

Remember what we are doing: In one scale are all the scientific experts in the world; in the other scale are the jokes of Dr. Riley and the points which I am going to examine. (Laughter.) First, he said all scientific men in the world are not agreed. I was invited into this country three years ago to lend a hand in this evolution matter. I read the entire anti-evolutionary literature of America. From that I selected the names of thirty scientific men who are being quoted in those western and southwestern states as scientific men who deny the fact of evolution. Where are those thirty names tonight? Not a single one of them. I debated with six leaders of the fundamentalists, those who are telling Tennessee and Arkansas that scientists are not agreed. I debated with Dr. Riley before. I have no quarrel with any intelligent believer. I have a quarrel with the man who will dupe and deceive on the whole scientific question.

Scientists are not agreed, he says. First, he mentioned Professor Austin Clark. There is no such professor in America as Austin Clark. Mr. Austin Clark is a young, scientific man who has made a life-study of sea-urchins. Will Dr. Riley explain how a life-study of sea-urchins makes a man an authority on the evolution of man? Will Dr. Riley show me a paper or any work of Mr. Clark in which he says that any living thing on this earth was "created"? He is an evolutionist. Everybody knows that he is an evolutionist. He gives an opinion as to the mode of evolution, but I want to see his own words where he has ever said that living things on this earth were created.

Then Dr. Riley quoted La Conte, who not only died about forty years ago, but was in his time the most zealous evolutionist in this country.

Then we had Professor Osborn, and I am sure when the echo goes around tonight that he was quoted in connection with this debate, you will hear a little in your papers from Professor Osborn. Professor Osborn, from whom I differ on many points, is the most prominent evolutionist in this country.

Where are the men, I ask Dr. Riley—remember you are told explicitly scientific men—who are not agreed about evolution? I know that they are not agreed about the origin of life. I know that they are not agreed about natural selection. But when did we ever ask Dr. Riley to let us teach any particular theory of natural selection or the origin of life in the schools of America? No one ever asked that those particular theories should be given to children.

The issue before you tonight is this: Is the fact of evolution true? Particular theories of evolution do not matter to you.

I repeat: All the living experts in the world are agreed and have been agreed for twenty-five years on the fact of evolution, and that is the fact that we want taught in the schools of the world. (Applause.)

I outlined five immense categories of evidence. Dr. Riley complained that I did so slightly. What would you expect in a twenty-minute speech but a slight outline of the massive evidence for evolution? (Laughter.) What did he make of my evidence, first, as to the geographical distribution? And, in particular, what does he make of New Zealand and Australia and their peculiar population?

Why, he says, if your doctrine of evolution is true, your higher forms ought to be evolved in those countries. Which shows that he does not understand even the fundamental idea of evolution. (Applause.) That doctrine of evolution is not that living things go on evolving to higher forms. The doctrine of evolution is that as long as the living thing is suited to its environment, there is no reason whatever why it should change if the change would be no advantage to it. Show me where the world is changing. Show me where the environment is changing, and then ask me for evolution. (Applause.)

If, on the other hand, Genesis is true, all your lions and tigers and elephants and men must have been in New Zealand and Australia, but some great catastrophe occurred, Dr. Riley says, and very neatly destroyed the lions, reduced all just to that level of population, the kangaroo, which the evolutionist says Australia had reached when it was cut off from the rest of the world. Would Dr. Riley now care to tell me why this mighty catastrophe wiped out all the animals higher than the kangaroo and left precisely that lower population?

Then we come to the vestigial remains. I am not going to argue about the Flood tonight. This is the first time I have got any fundamentalist to tell me that behind the whole case is the contention that all those strata of rock, all those animal remains, are the out-

come of a mighty flood that occurred some thousands of years ago. Why, I disdain to argue on such a point.

A Fundamentalist professor in London once argued that position with me and actually pointed out that in England we have whole beds full of fish-like remains. Why, the fish is the only animal on earth that would have had its golden age if there were such a deluge.

When it comes to the vestigial remains, Dr. Riley said, "Why didn't Mr. McCabe give me one idea?" I gave him one. I asked him what were those bits of gristle on the side of his head. Of course, he ignored that. All the medical authorities in the world will tell you that they are quite useless. He knows about this little fleshy body on the corner of the eye. He ignored it. He knows there is another, the hair on the arm. He ignored it.

But he goes to the pineal gland and he goes to the gill slits. It is forty years since any scientific man maintained that the pineal gland was useless. We have been experimenting thirty years, but until we discovered ductless glands, no man could suspect its use.

But when Dr. Riley ridicules for you the idea that that pineal body is the remains of a third eye, why, he has never read one serious word about the subject. You look at a reptile and you will find that third eye standing out like a billiard ball from the top of the head. It runs through the entire series of animal world, sinking lower and lower in the brain. I have seen photographs of the entire thing, and whatever new function the pineal body has turned to, it is one of the most obvious things in the world that it is the third eye in the top of its head. That New Zealand reptile has that third eye perfectly formed underneath the skin of its head.

Then Dr. Riley made fun of the gill slits. Will Dr. Riley tell us what writer he has been reading who talks of open slits? Certainly not my friend Haeckel; certainly no scientific man. There are no open slits as Dr. Riley said. Every scientific man will agree with him. He has got that from a scientific man because the slits in the condition of embryonic development were closed long ago. But the gill arches are still there. And what Dr. Riley has to explain is, not those closed slits, but the circulation of the blood in the human embryo. The arteries branch over exactly as in the fish, and if Dr. Riley can tell me any reason why the human embryo should have every time a perfect blood circulation and heart of a fish, I shall be more interested in that than listening to his jokes about science.

Those are the only points that I have taken down. I mean attempts on serious intellectual points out of Dr. Riley's address. I beg you to understand that I refuse to deal with any but the intellectual and scientific points.

Is there any other point whatever that I have to answer tonight? First, he denies that all scientists agree. Then tell me who disagrees?

Then he sweeps to one side the five lines of evidence I put before you. He ignores entirely the most important topics of all, and runs on to the deluge, runs on to Genesis, runs on to the growth of crime and immorality and heaven knows what.

To that I will only make one reply. It is sixty or seventy years ago since Darwin brought forth the doctrine of evolution. Oh, yes, I know perfectly well that the Greeks of 2,500 years ago had the rudimentary idea of evolution. But Dr. Riley ought to know that it did not perish of its own weakness. Who was the last great representative of Greek scientific thought? Hypatia. Did her doctrines die of their own weakness? No. She was torn from her chariot by a crowd of fanatical monks.

VOICES: Hear! Hear! (Applause.)

PROFESSOR JOSEPH McCABE: With broken crockery they tore the flesh from the bones of that last representative of the Greeks, and that was a symbolic act. In one mighty holocaust the whole of the Greek literature and scientific instruments were destroyed by the Christians whom Dr. Riley is quoting to you tonight. I wish to avoid in my debate tonight the subject of religion in evolution. I am dealing with that tomorrow night in the Community Church, but I have been dragged on to this topic.

Crime is expected of the doctrine of evolution. Where was the doctrine of evolution born? England. And every scientific man in England for thirty years has been an evolutionist, and you know what our statistics of crime in England are. (Applause and laughter.) Since Charles Darwin gave his doctrine to the world we have, not in proportion to population, but absolutely, cut down crime in Great Britain fifty per cent. (Applause.)

Why all this merriment? Why not give us facts? I invite Dr. Riley to take up the perfectly serious lines of argument that I have given you. Try again with the geographical distribution of animals. Tell us what did distribute them, and why the distribution coincided perfectly with our evolutionary explanation.

Dr. Riley said, I never proved that it coincided. Does he expect me to deal with all the animals and plants of the world in one evening in a one-quarter of an hour speech? Surely it is more logical for me to demand that he shall tell me at least of one exception. I am waiting for the one exception.

I am waiting for the one exception, the one fossil remain that has been found which is out of place, according to the evolutionary principle. I am waiting for the name of the one heavenly body which is not in perfect accord with the doctrine of evolution. I am waiting for the explanation of why, when we discovered a new instrument, chronology, quite independently of geology, it coincides perfectly with the story that the geologists tell. I am waiting for the answer to these things.

And if Dr. Riley is going to sacrifice the scientific men, if he is going to ask me about the old scientific men when the evidence was imperfect, if he is going to ask us to go back to those early ages, I bring him back to the situation of today. Here is a truth that we have been searching with mighty instruments for thirty years, and all our experts are agreed, while Dr. Riley tells things on which he ventures to differ from all those experts of the world. (Applause.)

(To be concluded in our next issue.)

NEW BOOKS

"WHAT IS MIND?" by George T. W. Patrick, MacMillan Co. \$2.50.

When we go philosophizing (metaphysically) we usually wind up nowhere. Scientific theorizing (with its continual checking against fact) really achieves new ground. This most practical truth is once more demonstrated in this brief summary of the answers of the metaphysicians and scientists to the problem of the nature of thought, consciousness and will. The author has thoroughly digested his authorities and writes most clearly—when the subject permits. It is not the author's fault that the subject often does not permit, for muddy metaphysics can come to nothing but muddy words. Elsewhere he proves how well he can tell this story.

He stands four-square with the recent scientific achievement; that mind and body are not two, but one; that mind is not a being, but a way of doing. His evaluations of behaviorism are soundly appreciative, yet critical. And yet he disappoints. With the emergent evolutionists he gives up the possibility of digging into and eventually explaining those new qualities which spring from new compounds of elements—chemical, organic, neural, social. That certainly is not scientific. Already in the simpler fields of atomic chemistry and physics we see hints of explanations.

Also he shows too much concern over the effects that this view or that may have on "the reality, dignity and spiritual worth of the mind," as if honest and careful scientists could ask any question but one, "Is the view true?" Plain wishful thinking this. He does not seem to have sensed the fact that, in its search for truth, science does not permit such thinking. It is to be regretted that so fine a presentation should be so marred. A. S. B.

"HUMAN EVOLUTION AND SCIENCE" by Francis P. Le Buffe, S. J. Sixth Edition, completely revised, sixtieth thousand. The America Press, New York, 1928. 10 cents.

Two of the three sections of this 32-page pamphlet are devoted to considering whether a good Catholic may believe in the evolution of man. The decision follows: "Thus the Catholic Church has an explicitly definite and official attitude on certain aspects of human evolution. Its attitude is absolutely and irrevocably condemnatory of the evolution of a human soul out of an animal, and of the tribal evolution of man's body; it is also, though not in the same infallible and irrevocable manner, against the evolution of Adam's single body from an animal ancestor." However, in view of the Galileo fiasco, a line of retreat has been left open. "Yet, according to

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theologians, if competent specialists, after thorough and conscientious investigation, should become convinced that the contrary arguments are cogent, i. e., not merely probable, even if strongly so, but clearly decisive, they may represent these views to the Commission, or hold them internally, giving no outward expression to them." Obviously, this section can interest only those who share the theological viewpoint expressed.

The first section of the pamphlet, however, is devoted to "Human Evolution and Science," and to an ostensible consideration of the scientific evidence. In summary, virtually all authorities cited are either no authorities at all, or antiquated; or else short quotations, out of context, are used to convey a meaning differing from that originally intended. (In other words, the usual bag of tricks of the anti-evolution propagandist.) It seems hardly necessary to list examples in detail. The changes are rung on the Piltdown skull, in entire ignorance of the fact that a second case of the same kind of association has been known for nearly ten years. A misleading impression is given that the Heidelberg jaw is mainly reconstructed. As a matter of fact, this fossil jaw is complete, except for a few teeth, and is unrestored. He makes the Rhodesian man sound very modern by listing all characters resembling modern man, and quietly omitting the primitive characters. (This is also a characteristic trick.) A few differences between monkeys and man are cited. Obviously, there must be differences between any two kinds of animals; if there were not, they would be the same kind of animal!

He implies that all our knowledge of the Neanderthal race rests on the original skull-cap discovered. Actually, parts of dozens of individuals, including several skulls and skeletons, have since been found. Under the heading, "Some Recent Fiascos," the "Patagonian skull" and the "second Java skull" are treated as if they were errors of scientists, instead of mere newspaper canards, about on the level of a reported sight of a flock of sea-serpents off Coney Island. There is also the usual gloat about Hesperopithecus, discussed by Ward in this journal (Vol. I, No. 6, p. 3). However, the last word may not have been said on this subject. Finally, the denial that gill-slits exist in the human embryo, indistinguishable from those present in a corresponding stage of the shark embryo, is contrary to fact. Obviously they do not develop into gills in the adult, as we have no gills. Citations of this kind could be multiplied *ad nauseam*, but these are a fair sample, as the rest of the discussion is of the same order.

One more quotation:—"The Old Testament and the New Testament both are intelligible only by holding

to Adam and Eve, the fall, original sin, the promise of redemption. Deny the oneness of parentage of the human race, you deny the fall, and its consequently transmitted original sin; deny the fall and its consequently transmitted original sin, you deny the need of redemption; deny redemption, you deny Christ, and Christianity becomes the baseless assumption its enemies claim it is."—Horace Elmer Wood, 2nd.

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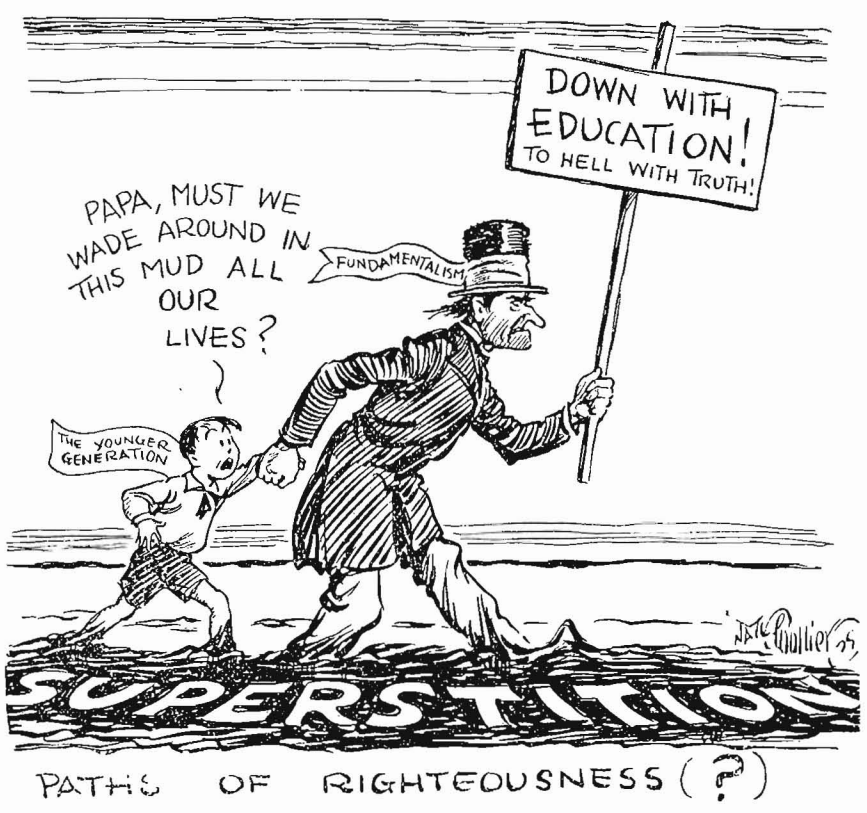
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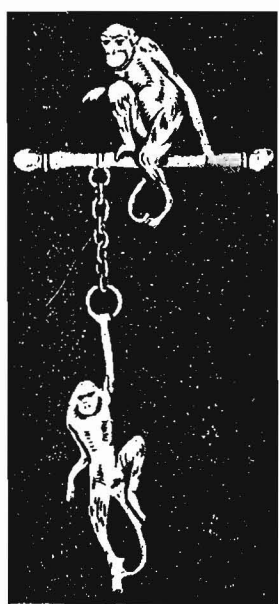
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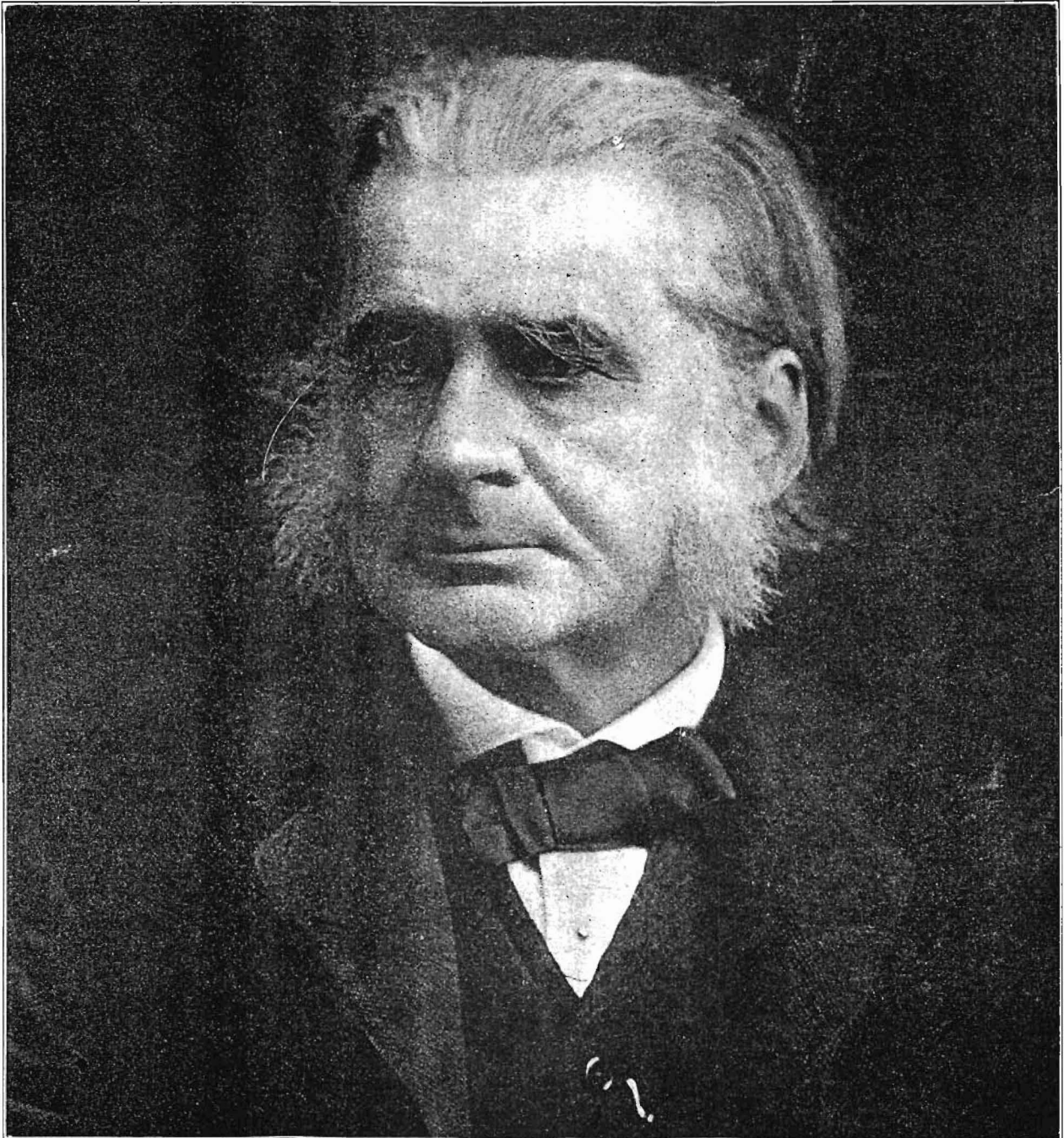
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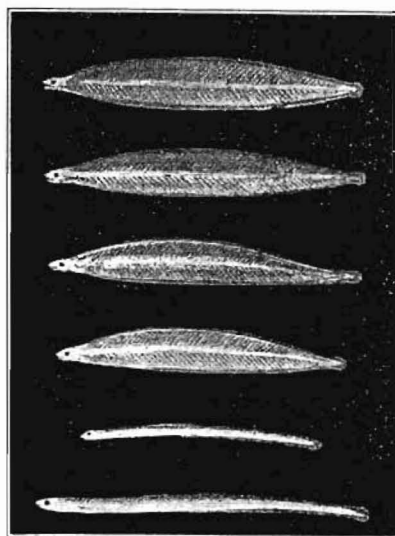
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The Life Story of An Eel

By PAULINE H. DEDERER

THE most famous person undoubtedly to inquire into the family antecedents of the eel was Aristotle, who left a record of his opinion that eels have no sexes or eggs, and that they arise from the entrails of the sea. Later speculations, less negative, but no nearer the truth, derived them from snakes, worms, or beetles, and—the latest suggestion, emanating from New England—even from clams.



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only one person has ever studied its development.

Now the matter is simplicity itself. All anyone need do is to join a deep-sea exploring expedition, embark on a yacht equipped with the last word in scientific apparatus, and proceed to a region of the Atlantic Ocean southwest of Bermuda—the famed Sargasso Sea where, in 1925, William Beebe and his company of scientists revealed in their "Arcturus Adventure."

Then you may watch the nets go down and scoop up quantities of the surface life of the sea, or plankton. In this oozy "sea soup" may be found the larvae of eels, varying in size from a quarter of an inch to three inches in length, thin as a willow leaf, and of about the same shape. Dr. Beebe described them as "mother-of-pearl eyes swimming round by themselves," the body being perfectly transparent. The finding of the larvae was not a new discovery, for Dr. Johs. Schmidt of Denmark had worked out the astounding migration path of the larvae and their metamorphosis into eels, publishing his results just before the Arcturus Expedition set out. But neither he nor anyone else knew what the larvae came from.

To unravel this mystery, ask the expert on larval fishes for a microscope and one of those pin-head dots

of living stuff dredged up from the sea depths, which are engaging her attention. Then, after a few days of more or less constant study—and let us hope the ship is not pitching too much—you may observe, as did Marie Poland Fish, the tiny dot actually transform into a larval eel. This discovery shows the importance of being in the right place at the right time. The right place—and the only place—to answer this question about eels, is in mid-Atlantic, the only region where our eels breed. Thus with a few accessories, like microscopes, a ship, patience, scientific training, and immunity from mal-de-mer, the question that perplexed Aristotle is answered. Simple enough!

Now the whole story is known. American and European eels have the same breeding ground, the sea near Bermuda. The larvae drift northward in the currents of the Gulf Stream, changing from leaf-like creatures into small rounded eels, or elvers. The American species seek the various rivers along the eastern shore of the United States, and swarm up-stream in great numbers, even wriggling over grass on rainy nights to reach the land-locked ponds in which they mature. In the fall of the year, the adult eels migrate from inland waters to the sea, traveling months before they reach the Atlantic breeding grounds, there to begin anew the cycle of development, and to die immediately after spawning.

European eels, migrating northward in the same ocean currents, take three years instead of one to metamorphose. They are therefore not ready to ascend rivers when they near our shores and are carried on north-easterly until they reach the shores of Europe. There, as elvers, they ascend the streams and rivers. Dr. Schmidt, in his report on The Breeding Places of the Eel, states that eels have been taken in waters in Switzerland at an altitude of 3,000 feet above the sea. He points out that although extensive migrations of fish are not unusual, the eels are really related to salt-water fishes, and "the remarkable point in their life history is not so much the fact of their migration out to sea to spawn, as in their leaving it in order to pass their period of growth in an environment so unusual for muraenoid fishes as fresh water."

The basis for the idea that eels arise from clams, already referred to, is probably the observation that clams often have a transparent gelatinous rod, about one inch and a half long, protruding from a break in their tissues. This rod is eel-like in form and size, and like the undeveloped eel is also transparent. It is a secretion from the stomach of the clam called the crystalline style. Its function was not definitely known until Dr. Thurlow Nelson of Rutgers University in 1925 explained its importance in aiding to separate the food materials from sand in the digestive tract of the clam.

The Super-Men of Cro-Magnon

By EDWARD GRIEG CLEMMER

THE rock shelter of Cro-Magnon is in the French village of Les Eyzies, in the Dordogne Valley. Here, in 1868, were discovered the first skeletons of



Cro-Magnon Man, as restored by J. H. McGregor

Cro-Magnon Man. Many other finds since then make our knowledge of this ancient race of Cro-Magnon very complete.

The Cro-Magnons lived in the Upper Paleolithic age, about 25,000 to 10,000 B.C. This age is divided into three periods, named, in ascending order, the Aurignacian, Solutrean and Magdalenian, after the towns of Aurignac, Solutre and La Madeleine where the

first type tools were found. For each period is distinguished by a different kind of tools, the type tools of one period not carrying over into the next, although the same basic design, may be preserved.

The Cro-Magnons were fine physical specimens, some skeletons indicating a height of six feet, four inches. The race as a whole was taller than the average modern European and far taller than the Neanderthal race. Also, the Cro-Magnon walked fully erect and held his head high. His brain equalled or excelled ours in cubical contents. Some have suggested that he might have been a mutation from the Neanderthal, but it is probable that he evolved in Asia and immigrated to the land of the Neanderthal.

In almost every case, the skeletons show care in burial, and at some stations the body was placed in a particular position, surrounded by shells or tools. Sometimes the grave had been filled with a special earth, and one skeleton had been painted red. All this indicates that this people considered burial an important ceremony, and they probably had a belief in an after-life. Certainly they valued the remains of their dead more than had any preceding race.

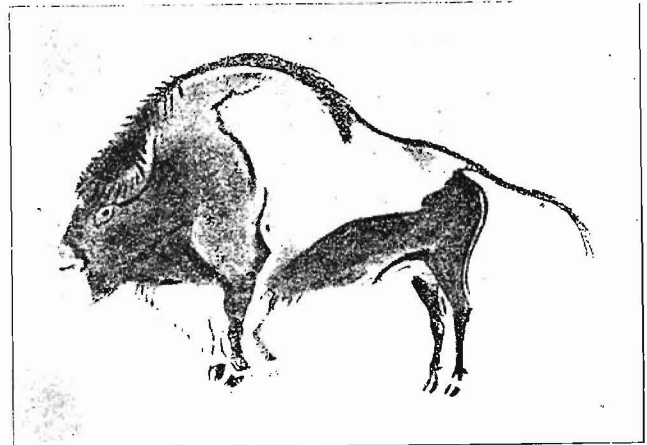
During the first or Aurignacian period, the cleaver, point and scraper were replaced by improved tools shaped from blade-like flint flakes from which small chips were removed by pressing instead of striking. In this manner, Aurignacian man made knives with an evident handle and sharply pointed graters for carving on bones and on cave walls. He also made bone and ivory points, cleft at the base for the end of his javelin.

In the Solutrean period the art of flint working by pressure flaking reached its highest development. The

most characteristic and beautiful tools were the laurel leaf and willow leaf points, the former two inches to a foot long, symmetrical, evenly flaked, straight, sharp and thin, the latter even more delicate and slender.

But all this marvelous dexterity eventually came to naught, for the Magdalenians who followed paid little attention to flint implements. They did use flint drills, saws, graters and scratchers, but they made real progress in transforming reindeer horn and bones into javelin points, needles, awls, fishhooks, harpoons and dart throwers.

Where the Magdalenians did excel was in their art, figures carved from ivory and stone, probably of magical significance, perhaps worshipped as idols, and on the walls of their caves, drawings and paintings. In 1878, Marquis Santyola, accompanied by his little daughter, was searching the cavern of Altamira, Spain, for relics of ancient man. Suddenly she cried out,



Painting of Bison in colors, Cavern of Altamira, Spain

"Toros! Toros! (Bulls! Bulls!)", and pointed excitedly to the ceiling of the cavern, all covered with the frescoes drawn by Magdalenian man. Subsequently other caves were discovered in France and Spain, their ceilings and walls similarly covered with drawings, some just outlines, others filled in with bright colors that have not faded to this day.

What happened to Cro-Magnon man we do not know. We do know that he lived in the cold of the Ice Age, and that when the ice melted away to the North, the animals he hunted for food left for colder regions. Some think he followed them and that the Eskimos are his descendants. Their culture is much like his, but their physical characteristics are very different. Probably this prehistoric race of artists just died out. Or the warm weather made life too easy so they degenerated and became the easy victims of more vigorous invaders from Asia or the Mediterranean region. Others, however, think that Cro-Magnon blood still courses through the veins of some Europeans, but of that we can only guess.

Written words could be kept straight, kept for future generations. Knowledge began to accumulate. Each generation started where the last one left off. Printing helped too. Knowledge could be spread, all over the world, to scholar and layman. With knowledge popularized, nearly everyone was thinking. Bright minds

got their starts, emerged to discover and invent, to help lift mankind higher. So the rate of progress increased. More thinking men and women on the job. More tested knowledge to work with. The result—man making his world better, making life happier. It sounds strange, but he talked himself into it.

When Birds Had Teeth

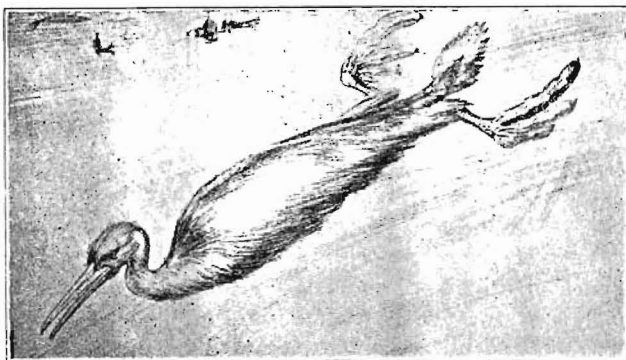
By FREDERIC A. LUCAS

SEPARATED by millions of years from that earliest of all known birds, the toothed *Archaeopteryx* of the Jurassic period (described last month), the next birds that we know come from the chalk beds of western Kansas. Time enough had passed for members of one group to have quite lost their wings, yet they still retained teeth, the most bird-like of them being quite unlike any modern bird in this respect. The first specimens were obtained by Professor Marsh in his expeditions of 1870 and 1871, but not until a few years later, after the material had been cleaned and was being studied, was it ascertained that these birds were armed with teeth. The smaller of these birds was not unlike a small gull and was, saving its teeth, so thoroughly a bird that it may be passed by without further notice. The larger, however, was remarkable

ance, and it was advantageous that they and their muscles dwindled, while the bones and muscles of the legs increased by constant use. By the time the wings were small enough to be used in so dense a medium as water, the muscles had become too feeble to move them, and so degeneration proceeded until but one bone remained, a mere vestige. The penguins retain their great breast muscles, as did the Great Auk, since it takes even more strength to move a small wing in water than a large wing in the thinner air.

As a swimming bird, one that swims with its legs and not with its wings, *Hesperornis* has probably never been equalled, for the size and appearance of the bones indicate great power, while the bones of the foot were so joined to those of the leg as to turn edgewise as the foot was brought forward, thus offering less resistance to the water. It is remarkable that these leg bones are hollow, because as a rule the bones of aquatic animals are more or less solid, their weight being supported by the water; but those of the great diver were almost as light as if it had dwelt on dry land. That it did not dwell there is conclusively shown by its feet.

The most extraordinary thing about *Hesperornis* is the position of the legs relative to the body, and this is something that was not even suspected until the skeleton was mounted in a swimming attitude. As anyone knows who has watched a duck swim, the usual place for the feet and legs is beneath and in line with the body. But in our great extinct diver, the joints of the leg bones are such that this was impossible, and the feet and lower legs must have stood out nearly at right angles to the body, like a pair of oars. This is such a peculiar attitude for a bird's legs that, although apparently indicated by the shape of the bones, it was at first thought to be due to the crushing and consequent distortion to which the bones had been subjected, and an endeavor was made to place them in the ordinary position, even at the expense of a dislocation of the joints. But when the mounting of the skeleton had advanced further, it became evident that *Hesperornis* was no ordinary bird and could not swim in the usual manner, since this would have brought his knee-caps uncomfortably up into his body. And so, at the cost of much time and trouble, the mountings were so changed that the legs stood out at the sides of the body, as shown in the picture, a position verified later by the discovery of the specimen now in the American Museum of Natural History, in which the limbs lay in just the position given them by the artist, Mr. Gleeson.



Drawing by Gleeson

The Toothed Diver. Hesperornis Regalis

in many ways. *Hesperornis* was a great diver, in some ways the greatest of the divers, slender and graceful in general build, looking somewhat like an overgrown, absolutely wingless loon.

The penguins, as everyone knows, swim with their front limbs—we can't call them wings—which, though containing all the bones of a wing, have become transformed into powerful paddles. *Hesperornis*, on the other hand, swam altogether with its legs—swam so well with them, indeed, that through natural selection the disused wings dwindled away and vanished, save one bone. *Hesperornis* was large, upwards of five feet long, and if its ancestors were equally bulky, their wings were quite too big for swimming under water as do the short-winged Auks which fly under water quite as they fly over it. Hence the big wings were closely folded upon the body to offer the least possible resist-

Hesperornis was probably covered with smooth, soft feathers. This we know because Professor Williston found a specimen showing the impression of the skin of the lower leg, as well as of feathers that covered the "thigh" and head. While such a covering seems rather inadequate for a bird of such exclusively aquatic habits, there seems to be no getting away from the

facts. And we do have in the Snake Bird, one of the most aquatic of modern birds, an instance of a similarly poor covering. Its feathers shed the water very imperfectly, and after long-continued submersion become saturated, which partly accounts for the habit the bird has of hanging itself out to dry.

Evolution: Fact or Fake?

Conclusion of the Debate held at Mecca Auditorium, New York, February 7, 1929, between Professor Joseph McCabe of England and Reverend W. B. Riley of Minneapolis on the question: "Resolved, That Evolution Is True and Should Be Taught in the Schools." Two previous issues contained the opening speeches and Professor McCabe's second speech.

THE CHAIRMAN: Dr. Riley again for twenty minutes. (Applause.)

* * *

DR. W. B. RILEY: Mr. Chairman, ladies and gentlemen: In my former address I began where the Professor left off. This time I propose to take the opposite position and begin where he began and track him down.

His declaration that evolution is a science is, as I stated in the first instance, a matter of counting noses. If the scientists agree, that settles it. How can that settle it? If the matter were a matter of science, there would be a demonstration of it. That is what I have listened for, and I have listened in vain.

If there is a living man on the face of the earth that can bring me one instance, either out of geological testimony, or, out of observation, where one species ever evolved into another, he will produce the first argument for this thing that has ever been found.

I want you also to see that the Professor is not sincere in reaching his conclusion, that because scientific men agree he is bound to believe it. He is not sincere.

The scientists of the world in religion are agreed, for the most part, on the existence of a God, certainly as perfectly agreed as the material scientists are agreed upon this subject, for while Evolutionists come to a kindred conclusion, they divide over every point in the so-called progress.

Now, I want to ask the Professor if he will accept these gentlemen, great, outstanding men in the realm of religion, and will go with them for a personal God because they are so overwhelmingly in the majority?

Why isn't the thing that is good in one realm equally good in another?

Here are a few people who have spoken of the existence of God—William James—and this is a matter of philosophy, not a matter of science at all. That is why it was born with the old Greeks. That is why it is reborn at the present time.

But William James opposes the Professor's views as set forth in every one of McCabe's books that I have read. Again, Professor McCabe repudiates the ontological argument of St. Anselm.

He will have none of Father Boedder's arguments.

He will have none of the reasonings of Dr. Warschauer as they proceed from cause to effect. He separates from Sir Oliver Lodge, concerning whom McCabe asserted:

"He is a man of science and does not cke out his arguments with quotations from ancient authorities or foreigners whose names and authority the reader is not likely to know."

The great Dr. Wallace, the matchless Lord Kelvin, the notable Sir J. J. Thompson, Principal Lloyd Morgan, Dr. Ballard, the immortal Bergson, Eucken, Martineau, LaConte, John Fiske; those several American professors who in 1897 published a book, "The Conception of God"; Dr. Rashdall, Professor James Ward, the seven Oxford men who in 1912 gave to the world their "Foundations," intended as a reconstruction of the Christian belief—these all have written sufficiently well to disturb my opponents and lead them to attempt an answer to each and every one of them, because they are united on the fact that there must be an infinite Creator back of nature; and yet, their united testimony makes no profound impression upon Mr. McCabe, so deeply immersed is he in the atheistic doctrine of evolution.

When Henry Fairfield Osborne, one of our first American scientists, claims, as he does in his recent book, that the great outstanding minds of the world today believe in God, and that many of them are advocates of the Christian religion; and even when no less a name than that of Robert Millikan joins him at once in the exercise of that faith and its far-reaching influence, the united testimony of these is all swept aside by McCabe. For what reason? To save the face of the false and atheistic philosophy of evolution.

With not one of them will he agree concerning God.

Why not be consistent? If we are going to accept this because the scientists say it, why not accept God in His creative acts, because men who are scientists in religion, have agreed upon the subject?

I do not need to tell you that I am not intellectual. The Professor will tell you that. He has already told you of his own! The man who is intellectual will never have to assert it. He doesn't need to assert it.

Now, he said I passed over some of his points. I believe I did, two of them. One of them was about the blue and white and red stars, or, to get them straight, blue, red and white stars. Will you tell me why in the world that confirms the evolutionary hypothesis?

There isn't a single hint in Genesis or a claim on the

part of any living, intelligent man to the effect that God made all stars or siderial systems in one moment. "In the beginning God created the heavens." You can stretch that just as far as you want to.

Go back sixty millions or two hundred and forty millions as others of them say, or go back if you want to into the billions and trillions as others of them say, or go back if you want to to the eternity of matter. Some worlds will be older than others. That is no confirmation whatever of Evolution!

Now, the other thing that I have forgotten to touch upon is that there is not, he said, one single form of life that does not answer to the evolutionary hypothesis. On the other hand, I dare assert that there is not one form of life, known to the human being, that does answer to it. Not one. Not one known living man has ever seen anything in nature's processes that could for one minute be employed as proof that the process known as evolution was going on at all. Not a thing.

I lectured one night in South Minnesota. A boy who had been two years in high school and who had the textbooks given him, came up to me and said:

"You have done very well. I think you have proved that we cannot prove our position. Neither can you prove yours."

I said: "How many illustrations would you like?"

He said: "Give me a few."

I said: "I can give you a million examples right on the farm." Have you ever heard of a hen that hatched anything than a chicken? Have you ever heard of any animal or any plant that produced after another kind? Have you? Varieties, yes, but species, none!

That is the testimony of Bateson, and the moment he said it, they discredited him. If you agree with us, you are a scientist, but if you dissent you are not a scientist and you are ignorant. That is the process of argument that Evolutionists employ.

Bees and ants we can trace farther back than almost anything else. Out of 9,560 separate specimens 93 species and 43 genera Wheeler and Ford said there was not a particle of change in all the ages throughout which they could trace them. No evolution anywhere. There is your case, Professor. You were asking for one. Set that down, if you please.

I read an article in the *Atlantic Monthly* some two or three years ago on evolution wrecked on the bees' knees. I said: "This is news to me." I did not know there were bees' knees. I can prove by the bees' knees that evolution is impossible.

He said that everything that the bee does involves him in sticky stuff. When he varnishes the base to build, when he gets into the comb that he works into the interstices of his body, it is sticky stuff. When he gets nectar, it is sticky stuff. Every single one of them would gum him up in such a way that, like some people—no personal reference, Professor—he would be stuck on himself; he would perish but for one thing: viz., he goes down on his knees and there are combs, and he cleans the antennae and proboscis on the combs.

How many million years would it require for that bee to evolve a comb on his knee that was adequate to its demand, and would it not perish a million times? While waiting the evolution, admit adaptation and you concede intelligent creation.

I want now to conclude what I have to say in this second address by going back again to the question as to whether it should be taught. Here, again, I charge the Professor with insincerity, absolute insincerity.

It is certainly the truth that the great moral law, the decalogue of the Bible, is true. If not, then all the nations of the world—his own included—have gone wrong; and yet he is not in the company of those that have pleaded to have that book placed or retained in the public schools. Not at all. Why not be consistent?

If you are going to teach everything, whether the people want it or not, why not bring the Bible that was banished back? There are only six states that will not permit the Bible to exist in them by law. There are six that demand its reading in the schools. And there are thirty odd that leave it up to the attorney general and to the superintendent of instruction, and in practically every case they have banished the Bible. (Applause.) I know the reason why it is rejected. It is impalatable to infidels and atheists!

If you are going to teach this theory, then teach side by side with it, the creative theory. If we are going to have men lecturing in school on evolution, then I dare them to let me lecture therein on creation. Only in a few instances can we get them to concede that favor.

I am here tonight to tell you that when this doctrine becomes a little more recognized, you will reap the fruitful harvest that is sweeping over our land now.

I spent the past summer in Scotland and Ireland. The overwhelming majority of the people of that country do not believe in this doctrine. They do not believe in it, and I know it from immediate contact with the people. I am not talking to you about a few professors. I am talking to you about people at large.

Unfortunately, a good many of the criminals of that country, just because it is easy to cross the ocean, have come over to our side, and we have more than belong to us. (Applause and hisses.)

There was a time when the deism doctrine—very much akin to this—in fact, it is identical with it in many respects—it says that God had nothing to do with creative acts; that He created the universe, and started it and went off and left it.

Now, they said He did not create it. That is the doctrine of evolution. It leaves God out.

And the Professor himself is a special advocate of the same doctrine that was put into Haeckel's "Riddle of the Universe" ruling God out. (Applause.)

And France went through the strain of deism.

And what was the result? The Reign of Terror.

Professor Williams of Oxford University said of the Nietzsche philosophy—that is this identical thing—that he was the only man that had lived that had the hardihood to carry it to its legitimate results, and when

(Continued on Page 12)

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IF YOU HAVE A NEW ADDRESS

notify us promptly, giving also your old address, so we can correct mailing list.

THAT TRUTH MAY PREVAIL

Among scientific men there is a continuous exchange of facts and opinions, the discovery and passing along of new knowledge and a consequent recasting of old theories to fit the new facts. Theories are frankly held subject to change, held now because they seem best to fit the known facts, but pretending to no finality at all. And this attitude holds for even those opinions most firmly evidenced and accepted, as witness the Einstein criticism of the "law of gravitation." Which all goes to say that your typical scientist is modestly open-minded. To him there is no last word, no final authority.

Therefore he is ever exploring, ever criticizing, ever thinking. Out of this comes more knowledge—and clearer theoretical guidance in the quest for still more truth. And it all comes of intellectual honesty which withholds no fact for fear of its logical consequences and spares no opinion whatever its source.

This attitude is one that fundamentalists, set on proving their "word of God," cannot appreciate at its honest worth. When a scientific evolutionist revises his theory, he it in most minor detail, they distort it into a general retreat and proclaim it victoriously far and wide. He honestly states facts that cast doubt and they magnify that into full confession. Your scientist is being honest and they jesuitical. That the truth may prevail, he states the whole case, doubts and all. For the "glory" of their gods they practice sophistry and appeal to prejudice. And so it is that he advances truth, while they obstruct it.—Allan S. Broms.

MECHANIST VERSUS VITALIST

"When the subject (of life) is reasoned about in terms of cause and effect, one group of thinkers, who call themselves *vitalists*, holds that life is due to the presence in living organisms of some 'all-controlling, unknown, and unknowable, mystical, hyper-mechanical force.' Such a view of life is satisfying only to the reasoning of the dogmatic thinker. It does not prove helpful to the scientist because it closes the mind to observable and verifiable fact when in search for truth; it removes the whole subject of adaptation to environment from the realm of investigation. No biologist makes use of such a working hypothesis—however useful the concept may be as a premise for the philosophical reasoning of an absolutist. There is a tinge of vitalism in the philosophy of a goodly number of those who consider themselves scientific; but to this extent they limit the range of their observations—they inhibit the use of their powers of induction.

"A far more satisfactory hypothesis or viewpoint for the study of vital phenomena, and one strictly in accord with scientific method, is called the *mechanistic view*. The viewpoint here taken is that this conception is consistent with the premises and working hypothesis used by the other natural scientists—the only one that is consistent with reasoning about the facts which stare the biologist in the face when he looks at the structure and functioning of organic tissue through a microscope. In other words, the point of view which has proved of the greatest advantage for scientific observation is, that life is a manifestation of energy in a peculiar kind of mechanism—a new kind of world stuff which is the physical basis of biological science."—H. H. Newman in "Modern Scientific Knowledge."

REGARDING "THE CAUSE"

It seems to worry the fundamentalists a lot that "Evolution teaches an effect or result without any cause." If evolution could teach the "cause" it would be an exception to all other natural laws. Does the law that "Water seeks its own level" teach anything about a cause? We know that water does seek its own level, because that happens to be the way this law operates. Through investigation we find that the earth pulls heavier objects toward its center, and this is called the law of gravity. Why accept these laws as perfectly natural, while demanding that evolution show some cause—a supernatural cause preferred?

Dr. David Starr Jordan, of Leland Stanford University, says: "Evolution and nature mean the same thing—'Orderly change.' To say that we should not study evolution is to say that we

should not study the earth or the stars, the plants, the animals, the growth of humanity." Luther Burbank says: "Those who would legislate against the teachings of evolution should also legislate against gravity, electricity and the unreasonable velocity of light, and also should introduce a clause to prevent the use of the telescope, the microscope and the spectroscope or any other instrument of precision which may in future be invented, constructed or used for the discovery of truth." Dr. Henry Fairfield Osborn expressed the views of all broadly educated men and women, and completely confuted the claims of "Bible opponents" of evolution, in saying: "No teacher can possibly teach zoology or any other branch of science truthfully and intelligently if evolution is left out; the cutting out of evolution from education is exactly like taking the heart from the body, for evolution is at the very heart or center of education and always will be."

Anti-evolution laws will be ignored the same as the law against teaching that the earth moves. This also conflicts with the Bible which states that Joshua made the sun stand still. Evolution is now being taught in all three of our anti-evolution states, by calling it "development." What I object to is that these laws cultivate hypocrisy. They are turning our schools into "speakeasies" and our teachers into "bootleggers." Bob Lyle.

AN EVENT WE ENJOYED

One of EVOLUTION'S most interested friends, Mr. A. Nielen, a youth of eighty years, world traveler, philosopher and photo artist, was a caller in New York last week. He delighted a group of New York readers of EVOLUTION with a travelogue, "A Trip Around The World," showing several hundred beautifully colored lantern slides of "the quaint, the queer and the beautiful," made from photos taken by himself. Mr. Nielen has an exceptional sense for the interesting and picturesque, and some of his slides are the most wonderful we have ever seen. His remarks while showing them were delightfully entertaining and contained many gems of wisdom. We look forward to another showing when he returns.

SKIP SEPTEMBER

Our next issue, Vol. II, No. 6, will be out the last of September, but dated October.

GIVE IT TO YOUR FRIENDS

The article on next page, "Our Knowledge of Man," by Dr. Hrdlicka of Smithsonian Institution, appeared as editorial in The Outlook. We shall reprint it also as a leaflet (\$1.00 per 100, \$5.00 per 1,000). Help distribute it far and wide.

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Our Growing Knowledge of Man

By ALES HRDLICKA

Reprinted by courtesy of The Outlook

An endeavor to account for man's origin has been universal. Study of the myths and beliefs of different peoples shows that there was no tribe, no ethnic group, no religious unit, that did not have some theory, however crude, as to how man came into existence. And before science came in, once an idea became set in any group, it constituted a dogma which effectively stopped or greatly retarded further thought in that direction. Religious dogmas, being directly associated with the deities (revelations), became particularly powerful. Had it not been for the Biblical account, especially, current thoughts about man's origin and his knowledge of himself as well as that of the rest of the living nature, would have developed much earlier.

An analysis of the conceptions reached on the subject before the advent of the scientific period, shows that the numerous forms group themselves into three main classes. They are: (1) wholly thaumaturgic, or (2) partly supernatural and partly natural, or (3) essentially natural.

The first class of theories regard man's origin as due to purely supernatural agencies and means, without speculating as to the details. Many of the anthropogenies of primitive tribes of today, together with those of some of the earlier Greeks, earlier Romans, and one of the versions of the Genesis, are or were of this nature.

The second class of views is subdivisible into two series. In the first, common to the Egyptians, all the Semitic peoples of Asia Minor, some of the Greeks (the Hephaestus myths) and to the second version of the Genesis, man's body is made of earthly materials (clay, bone, blood, etc.), with the life and soul added supernaturally. In the second subclass of these beliefs, common to some of the American Indians and others, man originates supernaturally from subterranean or recently emerged mythical birds or other animal forms.

The third, naturalistic, or scientific category of theories may again be separated into two subclasses. The first, held by some of the early Greek and other philosophers, such as Aristotle, and surviving largely to this day, teach a natural, evolutionary origin of the body, but believe in a distinct and higher origin of the "soul;" while the others claim an evolutionary origin of all man's attributes, physical and intellectual. The great difficulty in both these lines is the lack of a definition of the concept of "soul." Man has never known clearly and does not know yet just what is his "soul."

From the earliest time this third class of views as to man's origin dif-

fered widely from both preceding ones in being based on actual observation. In the beginnings, in the time of Anaximander and his followers, the observations were limited, imperfect and empirical; but men were gradually recognizing the close analogies between man and the rest of the organisms which surrounded him in the world.

True scientific observations by learned men, however, and deductions on the problem of human origin began during the latter part of the Eighteenth Century, and hence long before Charles Darwin. They attended on one hand the work of the anatomist and physiologist, on the other that of the naturalist and the geologist-paleontologist.

Buffon, Erasmus Darwin, Goethe, Treviranus, Gall, Geoffroy St. Hilaire, and a good number of others, headed eventually by Lamarck, and later Wallace, precede Charles Darwin; but it is the latter who, in 1871, in his "Descent of Man," gives the first comprehensive treatise on the subject.

Buffon, Erasmus Darwin (grandfather of Charles) and above all Lamarck, explained evolution by a gradual inheritance of "acquired characters" or structural adaptations, brought forth by environmental conditions. For Charles Darwin and his close followers, the essential factor in evolution, human or animal, was "natural selection" or, as Herbert Spencer termed it, the "survival of the fittest," working with the normal variation of every organism and of every part. Organisms vary; they also increase in numbers; the numerical increase leads to competition and struggle for existence; and in this struggle the most "fit" and best adapted to their environment survive and advance the group in their direction.

Since Lamarck and Darwin, the theory of human origin by evolution has been generally accepted by scientific men and enriched by a whole realm of observations and proofs, until what had originally been a theory has become one of the best documented pages of human knowledge.

At present, the essentials of man's origin through evolution are established facts. Still uncertain are many of the details of the highly complex processes involved, the exact sources from which man developed and the causes and ways of his differentiation; but these do not affect the soundness of the main conclusion.

Meanwhile science is endeavoring to solve more definitely the many still more or less obscure by-problems of human evolution. The efforts are partly a patient intensive search for additional material evidence, partly speculation. It is the latter that is respon-

sible for the various theories as to man's precise ancestry, the exact time of man's appearance, the true cradleland of humanity and the actual modes of human evolution; theories that, because of their variance, are by many mistaken for uncertainties of the main subject. It is such differences that may be seen in the recent writings of Osborn, Gregory, Clark and others. They depend on the basis and angle from which the still imperfectly explored field is contemplated and on other individual conditions. Similar human gropings after truth, before it has been fully revealed in material facts, are common to all branches of science. They are the useful "working hypotheses" of science, lasting until they are shown to be erroneous, or until replaced by better conceptions. They help toward the eventual reaching and crystallization of human knowledge.

Already, however, the cultured man and woman are becoming less curious about their remote ancestors, less concerned about the past, and are directing their attention to the next problems, which are man's further differentiation in the present, with the promises and indications for the future.

OFF WITH THEM FALSE WHISKERS

The Reverend Professor Leander S. Keyser, D.D., in "Bible Champion," May, 1929, page 226:

"That vehement propagandist, the magazine called *Evolution* . . . tells us some of the authors and publishers of text-books are keeping evolution in their books under cover in a deceptive way . . . cut out the word 'evolution' but inculcate (*sic!*) the doctrine in disguised form. Some people propose simply to substitute the word 'development' which may be used to describe the same doctrine. Let the good people of Tennessee, Arkansas and Texas be on their guard . . . People should remember that it is the theory of evolution that is not to be taught, by whatever name it poses."

Now the curious thing about this passage is that "the theory of evolution" is entirely legal for anybody to teach all he likes anywhere in North America. The only thing forbidden in "Tennessee, Arkansas and Texas" (the monkey states really are Tennessee, Arkansas and Mississippi) is *the descent of man*. If, then, "authors and publishers of textbooks" do not choose to exercise their legal right to include "the theory of evolution" itself under that particular name, or for that matter if they do, why should the Reverend Professor Keyser interfere with them? They are all within their rights under the actual statute.

Hasn't the Reverend Professor read his own fool law? Or does he think that other people haven't? E. T. B.

TWO EXPEDITIONS STUDY APES IN AFRICA

Two scientific expeditions from America are now in Africa studying the apes and primitive man, in both body and mind. One, sent by the American Museum of Natural History and the College of Physicians and Surgeons of Columbia University, includes Henry C. Raven, Associate Curator of Comparative Anatomy at the Museum, with extensive field experience in Africa and the East Indies; William K. Gregory, Professor of Vertebrate Paleontology at Columbia and author of "Our Face from Fish to Man" and other works on evolution; J. H. McGregor, Professor of Zoology at Columbia, authority on the anatomy of apes and man, and E. T. Engle of the College of Physicians and Surgeons, specialist in endocrinology and physiology.

They will study problems of man's evolutionary history and of his physical welfare in the future. On the medical side, studies will be made of posture and faulty mechanical adjustments, of the endocrine glands, of reproductive organs and processes, of blood tests and parasitic conditions. They hold that medical progress must be built upon broader knowledge of the fundamental laws of life and health, upon a better understanding of the origin and functions of the structures of the human body. More specifically, the purposes of the expedition are:

1. To bring back primate specimens for thorough anatomical, physiological and embryological studies under favorable laboratory conditions.

2. To make motion pictures and photographs of aboriginal tribes.

3. To procure complete adult specimens of different species of gorilla, previous specimens of adults having been limited to skins and skeletons. Because the gorilla closely approaches man in body structures, this feature is of outstanding scientific value.

The second expedition, headed by Harold C. Bingham, research associate of the Institute of Psychology at Yale, is working in the Belgian Congo under the auspices of the Carnegie Institution and Yale University, largely on problems of ape psychology. Motion pictures will record the individual everyday life of the African mountain gorillas in the reserve set aside by the Belgian Government for their preservation. Plans call for a whole year in the field.

TO SUPPLY LIBRARIES

Many thousands of people would be reached by the message of EVOLUTION if we could place the magazine in every Public and School Library Reading Room. Most libraries would be glad to display EVOLUTION in their reading room, even though their budgets do not permit them to pay

for it. Of course we can not send it free of charge, but we will be glad to supply Libraries at 60c. per year to the extent that our readers will furnish the funds.

A good start for this LIBRARY FUND is given by contributions from two friends, A. Kalmanoff, \$50, and W. T. Bush, \$20.

Will you also help? Every \$3 will send EVOLUTION one year to five libraries. You may either specify the libraries, or leave the selection to us.

ATTENTION, TEACHERS

A number of science teachers used EVOLUTION in their classes last year with splendid results. Some High School biology departments took 100 copies of each issue.

Our paid in advance bundle rate is only 5c per copy. A bundle of five for the nine issues that will appear during the school year amounts to \$2.25, ten \$4.50, etc. If you prefer we'll send you as many as you want on consignment at the regular news stand rate of 6c. to be paid after delivery. Simply write us how many to send you. All school orders will begin with the October issue, which will contain no commercial advertising.

PROMOTING EVOLUTION

Our closest friends know that we started without capital and have to raise several hundred dollars to bring out each issue. All surplus above production costs is used for promotion. When sufficient paid circulation has been achieved the magazine will be self-sustaining. In the meantime we invite readers to send funds, and we issue a share of our stock for every ten dollars sent. The following gave their support since the last issue:

M. Vonsovici, \$30.00; C. Peter A. Peterson, \$10.00; Herman Prange, \$3.00; Caspar Hodgson, \$10.00; L. T. B. Light, \$200.00; W. T. Bush, \$20.00; Michael Cohn, \$20.00; Joseph Block, \$20.00; Martin Dewey, \$200.00; John Dequer, \$10.00; E. E. Free, \$2.50; F. W. Hodge, \$4.00; A. S. Keshin, \$5.00; C. N. Clauder, \$1.00; Anne Frese, \$1.00; Bertha W. Howe, \$3.00; E. S. Wertheim, \$10.00; W. C. Michel, \$2.00; Geo. Welby Van Pelt, \$2.00; A Friend, \$25.00; Mignon Talbot, \$10.00; L. D. Abbott, \$1.00; Mrs. T. M. Nagle, \$5.00; Eda B. Schenker, \$4.00; Thos. Capek, \$4.00; Minot Simons, \$5.00; B. C. Gruenberg, \$5.00; J. David Houser, \$5.00; Tobias Sigel, \$10.00; A. L. Davis, \$2.00; Wm. F. Welling, \$.50; Ed. Heyn, \$1.00; Anna Reinstein, \$1.00; Lucy Hall, \$5.00.

The work can be pushed just to the extent that funds are furnished. Will you join this goodly group? To help spread the message of EVOLUTION.

The Calf Path

SAM WALTER FOSS

One day through the primeval wood
A calf walked home as good calves
But made a trail all bent askew, [should,
A crooked trail, as all calves do.
Since then three hundred years have fled,
And I infer the calf is dead.
But still he left behind his trail,
And thereby hangs my moral tale.

The trail was taken up next day
By a lone dog that passed that way,
And then a wise bell-wether sheep
Pursued the trail o'er hill and steep;
And drew the flock behind him, too,
As good bell-wethers always do.
And from that day, o'er hill and glade,
Through those old woods a path was made.

And many men wound in and out,
And dodged and turned and bent about,
And uttered words of righteous wrath
Because 'twas such a crooked path;
But still they followed—do not laugh—
The first migrations of that calf.
And through the winding wood-way
stalked,
Because he wobbled when he walked.

This forest path became a lane
That bent and turned and turned again;
This crooked lane became a road,
Where many a poor horse with his load
Toiled on beneath the burning sun,
And travelled some three miles in one.
And thus a century and a half
They trod the footsteps of that calf.

The years passed on in swift feet,
The road became a village street;
And this, before men were aware,
A city's crowded thoroughfare.
And soon the central street was this
Of a renowned metropolis!
And men two centuries and a half
Trod in the footsteps of that calf.

Each day a hundred thousand rout
Followed the zigzag calf about,
And o'er his crooked journey went
The traffic of a continent.
A hundred thousand men were led
By one calf three centuries dead.
They followed still his crooked way,
And lost a hundred years a day;
For thus such reverence is lent
To well established precedent.

A moral lesson this might teach
Were I ordained and called to preach:
For men are prone to go it blind
Along the calf-paths of the mind,
And work away from sun to sun
To do what other men have done.
They follow in the beaten track,
And out and in, and forth and back.
And still their devious way pursue,
To keep the path that others do.
They keep the path a sacred groove,
Along which all their lives they move;
But how the wise old wood-gods laugh,
Who saw the first primeval calf.

Ah, many things this tale might teach—
But I am not ordained to preach.

The Amateur Scientist

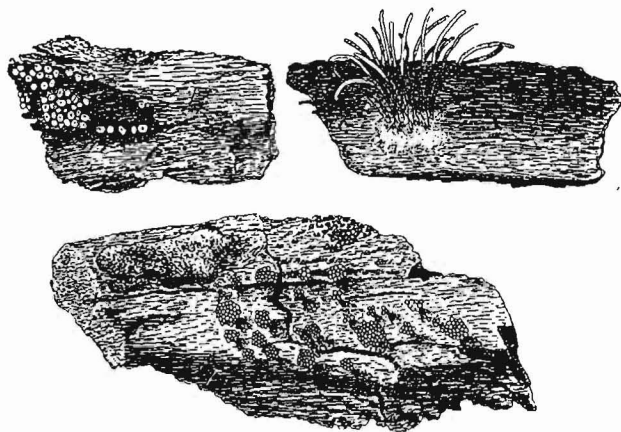
A MONTHLY FEATURE conducted by ALLAN STRONG BROMS

PLANT OR ANIMAL—WHICH:

We rarely have trouble distinguishing plants from animals. Usually animals can move and plants not, animals having nervous reaction systems, while plants have not. But Venus Fly-trap and various sensitive plants do react by movement and some very low one-celled plants actually travel. Also, sponges, which are animals, anchor themselves and just vegetate. So the scientist amplifies the popular tests by considering methods of getting food, details of structure, development, behavior, etc. But even the scientist is stuck when he meets the slime-molds.

jelly has disappeared shaping itself into most elaborate and beautiful spore bearing fruits. These are distinctive for each species and are easy to preserve. If you know what to look for, you can probably find some in your own yard.

But the first time you had better get a guide who knows what to look for and where. But guides are few. The New York Microscopical Society has one in Robert Hagelstein who has specialized on the *Mycetozoa*, for he thinks them animals, and takes us on a couple of "hunting trips" during the year.



Three common slime-molds on decaying wood; sporangia of *Trichia*; of *Stemonitis* (plasmodium remnant at base); and of *Hemitrichia* (with plasmodium)

He does not know for sure what they are—plants or animals. Some think them plants and call them Myxomycetes (slime-fungi), while others disagree and call them Mycetozoa (fungus-animals).

What makes the slime-mold so mysterious is that it lives its feeding life as a moving animal, and then settles down and reproduces itself by very obvious plant spores. As an animal, its working body is a mass of naked jelly called a *plasmodium*, suggesting the term "slime," which slips along slowly and engulfs its food like that simplest of known animals, the amoeba. While common in forests, in black soil, fallen leaves and decaying logs, it is seldom noticed, its shapeless yellow or other colored mass looking like nothing in particular. The plasmodium lives in wood and substratum and appears on the surface only when ready to fruit; sometimes it seems to be nothing but a wet spot on the log; usually it is inconspicuously small, occasionally eight inches across.

It is easiest to recognize at its plant stage, although it is then just a scattering of small, almost microscopic, spore cases. But it really looks like something, especially if you get a good close-up through a magnifying lens. Almost over night, the plasmodium

Sunday morning, July 7th, for instance, we boarded the ten o'clock Long Island train in New York for Mineola where he met us. He took us to a damp forest kettle-hole on the edge of the terminal moraine left by the last great Ice sheet. First he warned us against poison ivy and gave us an antidote to wash our hands with (one part of ferrous chloride to nine parts each of water and glycerine). Next he showed us samples from his own collection and then turned us loose among the dead leaves and rotting logs.

We found plenty of sporangia, but only two or three plasmodia. One of the latter was a greenish-yellow network of slime on the end of a dead twig. Another was just a "wet spot" on a piece of bark, but the wetness showed a pattern, and sporangia were already grown from part of it. Our real harvest was in sporangia. Each of us carried a cigar box and a supply of pins. When we found a colony of sporangia, we broke or cut off a piece of the wood or leaf and pinned it to the bottom of the box. This keeps the specimens from tumbling around and breaking the very delicate spore cases. The later preserving is just a matter of thorough drying and the keeping away of insects.

Our guide told us we had a really

EVOLUTION LECTURES

We have arranged a course of ten lectures to be given Saturday evenings, Oct. 12 to Dec. 14, inclusive, in the Labor Temple, 14th Street and Second Avenue, New York.

The general subject will be "Evolution: The Master Key," the idea being not merely to present the conventional evidence for evolution, but rather to show how the idea of evolution illumines every field of natural science today.

Four of the lectures will be given by Allan Strong Broms, our science editor, whose course of lectures was so well received last spring. The other six will be offered by authorities in the fields of Biology, Anthropology, Astronomy, Geology, Psychology and Education who will tell how the fact of evolution helps them to solve their special problems. Detailed announcement will appear in our next issue.

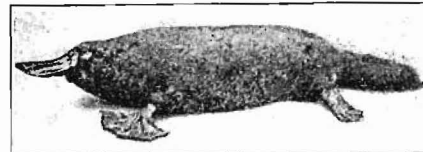
In the meantime we invite our friends to take course tickets in advance to furnish the necessary funds for advertising. Admission to single lectures will be 50c, but those ordering in advance will get HALF PRICE, that is TWO tickets for the entire course of ten lectures for \$5.00. May we hear from you?

The Duck-billed Platypus

A Rhyme.

by WALTER C. KRAATZ

Of all the Mammals the one most queer.
On all this wide, old, mundane sphere.
Is the so-called duck-billed platypus,
Four legs and fur like a regular "cuss";
But minus teeth; has bill for eats.
Though nourishing young on tiny teats,
She lays her eggs like a regular bird.
Or reptile, no matter if it seems absurd.
It means to us who are able to think:
This beast is a real connecting link.



poor day, though we felt quite happy in having found so many after such a recent opening of our eyes. But it seems there are three hundred species throughout the world and this one kettle-hole had already yielded about a hundred, a couple of them quite new. We had nothing like that and he was really disappointed, for he knew his logs by their first names and expected much more of them, especially when he brought company. However, there is another day coming, for the slime-molds are to be found from March to December, and we are to have another "hunt" on September 29th, the same guide, the same place, the same train, and the same good time. Incidentally, everyone is invited. Just bring your lunch and a hand magnifier.

(Continued from Page 7)

he did it it proved a transvaluation of all values and the degradation of all moralities.

As an American citizen born in this country, after generations and generations of ancestral voters, I stand for my land, and while my voice lasts, I expect to lift it up in opposing a doctrine that hasn't a scintilla of evidence in the heaven above, the earth beneath, or the waters under the earth. (Applause.)

I say as a father of six children, as a teacher of four hundred in my school, as a taxpayer, and consequently a citizen, I shall do my utmost to put this thing out of the public schools of America. I thank you.

(Applause and hisses.)

THE CHAIRMAN: Professor McCabe will now close with five minutes.

PROFESSOR JOSEPH McCABE: I am afraid this audience must be entirely fundamentalist and is trying to prevent me from getting my precious five minutes (referring to prolonged applause). (Laughter.)

Dr. Riley, as I expected, in his first speech declined to follow the lead that I gave him and waited until his second speech, knowing that I have only five minutes to answer that Niagara of argument that he put out. The order of this meeting has been altered at the request of Dr. Riley. After the second speech we were to have ten minutes each in which we might have dealt more or less satisfactorily with each other. As it is, what do you expect me to do in five minutes? Fortunately, the greater part of what Dr. Riley said was entirely irrelevant to this debate tonight.

(VOICES: Right! Hooray! Applause.)

I am appealing only to such members of this audience as are going to give us a sober, intellectual verdict on the question. The best thing that I could do to give Dr. Riley a chance was this: to inform him that all scientific men are agreed. I do not count noses. I did not ask you to believe evolution because all scientific men are agreed. I said if they are all agreed, you will expect something very serious and very substantial from Dr. Riley. Did you get it? (VOICES: No.)

So far as my analysis goes, he has at last given me one thing to reply to. I told him that all the facts of the universe are in keeping with evolution. He asked me to run over all the facts of the universe and show it. (Laughter.) Surely, the best opportunity I could give Dr. Riley was to tell me one that is inconsistent. That is logic. Tell me one that is inconsistent and my case falls. At last I got one supposed inconsistency, the bees. (Laughter.) And once more Dr. Riley does not know the elements of the subject. (Laughter.)

Of fourteen families of bees twelve have no means of making wax or using wax whatever, and the only fossil bees we have belong to those families that never make any wax whatever. Dr. Riley said the bees and ants are the oldest forms of life. They are, on the contrary, amongst the youngest.

I claim, ladies and gentlemen of the jury, I claim that I put before you this statement: The whole universe is the basis of evolution, and Dr. Riley must

show you facts which will bring that statement to the ground and show things inconsistent with evolution. He has not done so. I claim, therefore, in conclusion, that this anti-evolution campaign is founded upon a complete ignorance of scientific teaching. (Applause.)

Dr. Riley has accused me of insulting America. I have been for ten years the most friendly interpreter of American life in the whole of Europe. Never for a single moment have I said a word against America. That is why I am here before you tonight.

Well, I submit to you that the doctrine of evolution is proved. This anti-evolution doctrine, which has made America conspicuous before the educational world, is not proved. It rests upon complete—not only complete ignorance, but complete misrepresentation of science from beginning to end. (Applause.) And while I admit that parents can determine what shall be taught to their children. I do not admit that any expert people shall not freely tell parents what is true and what is not true. Who is going to decide? Ladies and gentlemen, I put it up to you. You have seen tonight how the anti-evolution campaign in America is engineered. (Applause.)

I appeal to you. This is my last word, and believe me as in other matters I have been explaining in England for years what is the meaning of the fundamentalist campaign. I ask that New York shall at last assert its rightful position as the cultural leader of one of the greatest civilizations of modern times. I ask that America shall purge its intellectual prestige of this stain that has been imposed upon it, and that you will be prepared to lead, not only your States, but lead the world in wisdom and in justice and in peace. (Prolonged applause.)

The Chairman took a rising vote of the audience, which expressed itself at least ten to one in favor of Evolution and Prof. McCabe. The vote recorded by the official judges was 12 for the Affirmative and 17 for the Negative, but the poll of the High School Class seated on the stage as unofficial judges was 36 to 5 in favor of the Affirmative.

HOW IT HAPPENED TO HAPPEN

SOME of our friends can not understand how we could select judges for the New York evolution debate who could vote 17 to 12 in favor of the fundamentalist. In fairness to Prof. McCabe we should explain. The original plan was to have 16 judges selected by EVOLUTION, 16 by friends of Dr. Riley, and 1 by mutual agreement. The afternoon of the debate we had secured our 16 acceptances, but only 5 of Dr. Riley's Committee had accepted. So, with our consent, he invited a long list of friends, and since he could not tell beforehand which ones would come we agreed to pass them all through at the front door with the understanding that the proper number would be selected to sit as judges when they arrived backstage.

Not all of the judges selected by EVOLUTION showed up, but enough of Dr. Riley's friends arrived to bring the total list up to 29. The gentleman in charge of the stage did not know one from the other and seated them all. There was some discussion regarding the matter when the vote was about to be taken, but it was then too late to do anything about it, and Dr. Riley is entitled to all the consolation that he can derive from the judges' decision under the circumstances.



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NEW BOOKS

MODERN SCIENTIFIC KNOWLEDGE, edited by Frederick A. Cleveland. Ronald Press, \$4.50.

This one-volume Outline of Modern Science deserves reading. Unlike that otherwise excellent "Outline" by Thomson (adequate only as an "Outline of Biology"), it really covers the whole field. Written originally by a number of authors, its several sections vary in excellence, but remain popular throughout. One would expect marked gaps and duplications in a symposium of this sort, but it has been so well edited and obviously rewritten that it has the continuity and coherence of single authorship.

The introductory section deals appreciatively with the scientific method and the place of science in modern life and thinking. The contrast with the unscientific thinking of the theological and other "absolutists" is forcefully set forth in a way that leaves little to be desired.

Much of the material is necessarily "old stuff," but very properly emphasis is placed on recent scientific developments. The chapters on atomic physics and chemistry, on the colloidal state of matter and on genetics are noteworthy. Especially so are those on Psychology, in which the viewpoint is illuminatingly evolutionary and behavioristic, as is suggestively indicated by each of several chapter headings containing the words "adjustive mechanism." It is to be regretted that the inconsequential chapters on Personality and especially those on Sociology do not continue this keynote, but lapse into a static and legalistic treatment that fails completely in outlining the really basic achievements in social science, and so finish most weakly a valuable book otherwise excellently conceived and done.

The text is sparingly, yet adequately, illustrated with well chosen and pertinent drawings from a wide range of sources. Nearly every chapter is followed by bibliographies and review questions for the benefit of the more thorough student. Each question is stated suggestively and followed by a brief list of references. In addition there are two general bibliographies with each chapter, one for popular reading, the other technical. These special features add much to the value of the volume as a textbook and as a busy man's guide to the basic facts and principles of modern scientific knowledge. A. S. B.

WHO WOULD?

No wonder science puzzles us,
Such noble names it plies;
Who'd ever dream *ichneumonides*
Were tiny, tiny flies?—Ex.

OLD CIVILIZATIONS OF THE NEW WORLD. By A. Hyatt Verrill. Bobbs-Merrill Company, 393 pages. Illustrated. \$5.

The most fascinating and at the same time the most perplexing field of archaeology is the study of the pre-history of Central and South America. Henry George's words, "Behind dead empires, dim ghosts of empire loom," were never more aptly applied than to the vast ruins and remains of Mexico, Panama, Colombia, Honduras, Ecuador, Bolivia, and Peru. The casual reader who fancies that all of American archaeology is comprised in a survey of the Mayas, the Aztecs, and the mis-called Incas, with a side glance at the Mound Builders, the Cliff Dwellers, and a few other extinct peoples of our own continent, is due for both a shock and a thrill in Dr. Verrill's absorbing and enlightening book.

Who were the Coclé dwellers, whose city Dr. Verrill himself discovered? Who were the Chinú? The Chibchas? The Tiahuánacans? The Pre-Incans? The Toltecs—if such a race ever existed? The Nasca? The builders of the pink porphyry cities of Peru? Where did these various peoples come from? When did they flourish? Why was their empire destroyed in each case, and when? Why is there in no instance any gradual development of a culture, but utterly dissimilar civilizations appear full-grown, without antecedents? Why were the tropics, where progress is usually slowed up, in America the scene of the greatest civilizations, whereas temperate South and North America displayed no such phenomenon? Were any of these peoples related or culturally connected, and if so, which?

These and many other questions Dr. Verrill can answer only by saying, "We do not know. In a day or a year we may discover the answer, but at present the problem is insoluble." One thing he does know, however, and gives the evidence for—the vast antiquity of man, and of civilized man, in America.

"Old Civilizations of the New World" is written by a man who is not only a real authority on his subject, but also a rarely interesting writer. In dealing with the better known civilizations, those of the Aztecs, the Mayas, and the Inca dynasty of Peru, he is no less enthralling in his narrative than when he is revealing for the first time in popular form the known facts of the still more mysterious and obscure peoples of South America. Discoverer not only of Coclé, in Panama, "the Pompeii of America," but also of the only wheels known in the remains of prehistoric America, and, in his earlier work as a zoologist, of the supposedly extinct *Solenodon paradoxus*, in Santo Domingo, and of the strange bearded Indians of Bolivia, he seems to have a genius for bringing

to light new and pregnant finds in two distinct branches of science.

Diffidently I suggest a possible explanation of one of his minor mysteries in this book. In commenting on the impossibility that such work as must have been done by several of these extinct races could have been accomplished with the very crude stone implements which alone are found with them—work which ranges from absolutely true fitting of massive stone building blocks, or intricate lacework designs cut out of solid rock, to engraved gold beads smaller than the head of a pin—Dr. Verrill states that he finds no possible explanation why, granting that metal instruments might have disappeared (though this is improbable if they were deposited with the finds, for even feather-work and textiles are preserved in that dry atmosphere), the badly made stone tools and weapons should be there at all. Is it not possible that they were left just because they were useless—because they were ancient, or imitations of the ancient, and had a religious significance? Most of these ruins are of temples, and we know to this day how outworn customs and implements are still retained in church ritual. The workers, in other words, took their developed tools home with them; but the stone axes used by their remote ancestors had a place of honor at the altar.

Be that as it may, a book like this fires one to wonder and contemplation. "Old Civilizations of the New World" is literally a truly inspiring work.

Maynard Shipley.

Evolution Book Shelf

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